P. O. Box 3583,
Stanford,
CALIFORNIA.

September 26, 1965.

The District Engineer,
Monterey Flood Control and Water
Conservation District,
P. O. Box 930,
Salinas, California.

Dear Sir,

The Santa Clara Water Commission is in the process of reviewing its present pricing schedules for agriculture and urban water. I am attempting to obtain for their use in this study a selective list of such schedules presently in use by other agencies. A second endeavour is to obtain information on the water pricing policy of various agencies.

I understand that your district recently had a study carried out by John Mamer entitled "Alternate Repayment Schemes for the San Antonio Dam Project".

I would be very grateful if you would provide me with a copy of this report and I would appreciate your permission in allowing me to make this report available to the Santa Clara Water Commission.

Sincerely yours,

C. A. Gannon

P. O. Box 3583
Stanford, California
September 28, 1965

The District Engineer
Monterey County Flood Control
and Water Conservation District
P. O. Box 930
Salinas, California

Dear Sir:

The report "Proposed Methods of Financing the San Antonio Dam Project" reached me yesterday.

May I take this opportunity to thank you for providing me with this report and for your early reply to my request for this report.

I am sure this report will provide the Santa Clara County Flood Control and Water District with much valuable information.

Thank you once again.

Sincerely yours,

C. A. Gannon

APPENDIX C:

A Directory of California Water Agencies including:

- *Water Districts
- *Flood Control and Water Conservation Districts
- *County Water Districts
- *Municipal Water Districts
- *County Waterworks Districts
- *Metropolitan Water Districts
- *Water Storage Districts
- Irrigation Districts

*Listed by county.

Source: State of California, Department of Water Resources, Sacramento

(List as of June 30, 1964)

List of CALIFORNIA WATER DISTRICTS as of June 30, 1964

AMADOR COUNTY

Willow Springs Water
Inez Burrow, Secretary
P. O. Box 2608
Sacramento

BUTTE COUNTY

Biggs-West Gridley Water
W. C. Jensen, Secretary
Rte 2, Box 757
Gridley

Butte Water
Paul Hunzeker, Secretary
Box 425
Gridley

COLUSA COUNTY

Compton Water
Meryle Swift Thompson, Secretary
544 - 10th Street
Colusa

Cortina Water
Mrs. Eugene P. Arambel, Secretary
Box 663
Williams 95987

La Grande Water
E. La Grande, Secretary
Rte 1, Box 33
Williams

Westside Water
Charles Tuttle, Jr., Secretary
Box 427
Williams 95987

EL DORADO COUNTY

Salmon Falls Water
Frank O. Black, Treasurer
2160 Royal Road, Suite 29
Sacramento

FRESNO COUNTY

Broadview Water
Robert Chuck, Secretary
1535 - 11th Street
Firebaugh

(Fresno County Cont'd)

Dog Creek Water
Bonner Semple, President
1100 Tollhouse Road
Clovis

Farmers Water
Betty Ratcliff, Secretary
2135 Fresno Street
Fresno 93721

Fresno Slough Water
Harry Marchini, Secretary
Box 199
Tranquillity

Garfield Water
H. E. Andrews, Secretary
4113 E. Copper Ave.
Clovis

International Water
Leola Harlan, Secretary
9036 E. Tollhouse Rd.
Clovis

Kings River Water
Norman H. Holt, Treasurer
327 Oatman Street
Sanger

Mercy Springs Water
John E. Williams, Secretary
51170 W. Althea
Firebaugh 93622

Oro Loma Water
Mamie J. Miles, Secretary
P. O. Box 92
South Dos Palos

Panoche Water
F. E. Redfern, Secretary
52027 W. Althea Ave.
Firebaugh 93622

Pleasant Valley Water
Wallace E. Weeth, Secretary
Box 931
Coalinga

(Fresno County Cont'd)

Raisin City Water
J. Riddle, Secretary
Box 114
Raisin City

Round Mountain Water
Vito De Leonardis, Secretary
14748 E. Shaw Ave.
Sanger

Tollhouse Water
Einar Cook, Treasurer
4092 E. Shaw Ave.
Clovis

Traction Water
Richard Goodman, Secretary
Box 225
Fresno

Westlands Water
Stewart P. Smith, Secretary
Box 4006
Fresno 44

Widren Water
Ivan Bartell, Secretary
Box 96
Firebaugh

GLENN COUNTY

Capay-Rancho Water
Neal D. Butler, President
Rte 2, Box 146
Orland

Chrome Water
Edward E. Garton, Secretary
Box 605
Orland 95963

Kanawha Water
Vernon Pieper, Treasurer
Box 166
Willows

Orland-Artois Water
Edward E. Garton, Secretary
411 Walker Street
Orland

IMPERIAL COUNTY

Salton Sea Water
Mrs. C. J. Adams, Assessor
7839 Calle Casino
Cucamonga

KERN COUNTY

Antelope Plains Water
Oran W. Palmer, Secretary
359 Haberfelde Building
Bakersfield

Corcoran Road Water
Mrs. F. M. Mossman, Secretary
417 S. Hill Street, Rm. 1020
Los Angeles 13

Henry Miller Water
Vincent McGovern, Secretary
Rte 3, Box 893
Bakersfield

Lost Hills Water
Oran W. Palmer, Secretary
359 Haberfelde Building
Bakersfield

Rag Gulch Water
Howard K. Nielsen, Secretary
1407 Thomas Way
Delano

KINGS COUNTY

Devil's Den Water
Albert Armor, Secretary
P. O. Box 1832
Fresno 93717

Dudley Ridge Water
S. S. Whitehead, Secretary
P. O. Box 104-(c/o L. C. Wallace)
Corcoran

Hacienda Water
Philip Marskey, Secretary
1107 Norboe Street
Corcoran

Lakeside Irrigation Water
Keith Schwenk, Secretary
P. O. Box 493
Hanford

(Kings County Cont'd)

Melga Water
John W. Hibbard, Secretary
P. O. Box 877
Corcoran 93212

Nunes Water
Albert Armor, Secretary
P. O. Box 877
Corcoran

Salyer Water
C. Everette Salyer, President
Box 488
Corcoran

Upper San Jose Water
Marjorie Smith, Secretary
346 D Street
Lemoore

LAKE COUNTY

Clearlake Water
B. L. Hanelt, Secretary
Box 1227
Clearlake Highlands

LOS ANGELES COUNTY

Newhall County Water
Helen L. Thompson, Secretary
Box 328
Newhall

Walnut Valley Water
Edmund M. Biederman, Secretary
Box 215
Walnut 91789

MADERA COUNTY

Chowchilla Water
H. V. Eastman, Secretary
Drawer 905
Chowchilla

Clayton Water
Rebecca Clayton, Secretary
4831 Highway 152
Chowchilla 2

Gravelly Ford Water
Wallace E. Emmert, Treasurer
Box 68
Madera

(Madera County Cont'd)

Mesa Water
Callie Roberts, Secretary
1111 Fulton, Suite 504 Helm Bldg.
Fresno 93721

Progressive Water
Ed. Howe, Secretary
330 N Street
Fresno

MERCED COUNTY

Centinella Water
George H. Johnston, Secretary
206 Sansome Street
San Francisco 4,

Eagle Field Water
John E. Williams, Secretary
51170 Althea
Firebaugh 93622

Grasslands Water
Roy Lower, Manager
636 "I" Street
Los Banos

La Branza Water
Findley Upton, Secretary
Box 506
Chowchilla

Laguna Water
George K. Antoine, President
656 Adams
Los Banos

Lansdale Water
George H. Johnston, Secretary
206 Sansome Street
San Francisco 94104

Le Grand-Athlone Water
William Crump, Secretary
9158 So. Minturn Rd.
Chowchilla

Mustang Water
Laurence Harrison, Secretary
Box 37
Westley

Pacheco Water
Bernice Pernetti, Treasurer
Box 125
Los Banos

(Merced County Cont'd)

Quinto Water
Lawrence D. Harrison, Secretary
Box 37
Westley

Romero Water
Eugenia M. McCabe, Secretary
2424 Russell Street
Berkeley 94705

San Luis Water
Joseph W. Carlucci, Secretary
Box 666
Los Banos

Stevinson Water
Georgette Kelley, Secretary
Box 818
Newman

MONO COUNTY

Antelope Valley Water
Henry Berrum, Secretary
Topaz

Mammoth Camp Tract Water
Robert Schotz, Secretary
Highland Resort Old Mammoth Rd.
Mammoth Lakes

MONTEREY COUNTY

San Ardo Water
Silvey A. Folleta, Treasurer
Box 238
San Ardo

NAPA COUNTY

Spanish Flat Water
Robert H. Zeller, Secretary
929 Randolph Street
Napa

ORANGE COUNTY

El Toro Water
Joanne Prothero, Secretary
401 West 8th Street
Santa Ana

Irvine Ranch Water
Max C. Hoeptner, Secretary
Box 37
Tustin 92680

(Orange County Cont'd)

Los Alisos Water
Karl B. Rodi, Secretary
611 Wilshire Boulevard
Los Angeles 17

Moulton-Niguel Water
Eugene W. Bell, Secretary
401 W. Eighth Street
Santa Ana

Talbert Water
H. Roger Howell, Secretary
401 West 8th Street
Santa Ana

PLACER COUNTY

McKinney Water
M. R. Mac Millan, Treasurer
Box 2149
Redwood City

PLUMAS COUNTY

Last Chance Creek Water
Doris Guidici, Treasurer
Box 24
Vinton

RIVERSIDE COUNTY

Calimesa Water
Walter A.Page, Secretary
110 Edgemont
Redlands

Dos Palmas Water
Ed. Eldridge, Secretary
c/o Clayson, Stark, Rothrock & Mann
Box 670
Corona

Elsinore Water
Elizabeth E. Griffin, Secretary
16899 Rice Street
Elsinore

Fern Valley Water
Hugh B. Greet, Secretary
Box 387
Idyllwild 92349

Panorama Water
Jacob Silverman, President
8111 Beverly Boulevard
Los Angeles 90048

(Riverside County Cont'd)

Ruisenor Water
Lloyd H. Skjerdal, Treasurer
210 Post Street, Rm. 802
San Francisco 94108

Val Verde Water
County Auditor

SACRAMENTO COUNTY
Clay Water
Wilbur Trowbridge, Secretary
926 J Building, Rm. 216
Sacramento 95814

Omochumne-Hartnell Water
Muriel Blodgett, Secretary
Rte. 2, Box 2254
Elk Grove 95624

SAN BENITO COUNTY
Pacheco Pass Water
L. G. Barrett, Secretary
836 Central Avenue
Hollister

SAN DIEGO COUNTY
Alpine Highlands Water
Frank W. O'Neill, Secretary
Box 335
Alpine

Bellford Village Water
V. P. Bell, Secretary
257 E. 4th at Juniper
Escondido

Bonsall Heights Water
Ed Conner, Secretary
Box 89
Bonsall

Borrego Water
Fred C. Corey, Jr., Secretary
Box B
Borrego Springs

Lakeside Farms Water
Ruby A. Nelson, Secretary
Box 356
Lakeside

Moosa Water
Guy C. Earl III
Gazador Lane
Fallbrook

(San Diego County Cont'd)

Orchard Water
John Norwood, Secretary
8262 University Avenue
La Mesa

Questhaven Water
Gordon R. Bleth, Treasurer
Box 1628
Escondido

Riverview Water
W. A. Master, Jr., Secretary
Box 356
Lakeside

SAN JOAQUIN COUNTY
Plain View Water
A. J. Rhodes, Secretary
Box 964
Tracy

SHASTA COUNTY
Bella Vista Water
R. J. Presleigh, Secretary
1832 Butte Street
Redding 96001

SOLANO COUNTY
Maine Prairie Water
Goodwin Horigan, Secretary
Box 73
Dixon 95620

SONOMA COUNTY
North Bay Water
Wm. Bisso, Secretary
5400 Sears Point Road
Sonoma

STANISLAUS COUNTY
Davis Water
Lawrence D. Harrison, Secretary
Box 37
Westley

Del Puerto Water
Lawrence D. Harrison, Secretary
Box 37
Westley

(Stanislaus County Cont'd)

El Solyo Water
Mrs. Mary Noblitt, Secretary
Rte. 1, Box 700
Vernalis

Foothill Water
Lawrence D. Harrison, Secretary
Box 37
Westley

Hospital Water
Lawrence D. Harrison, Secretary
Box 37
Westley

Kern Canon Water
Lawrence D. Harrison, Secretary
Box 37
Westley

Orestimba Water
Lawrence D. Harrison, Secretary
Box 37
Westley

Patterson Water
Roy Klopping, Secretary
Box 685
Patterson

Rock Creek Water
W. S. Orvis, Treasurer
Farmington

Salado Water
Lawrence D. Harrison, Secretary
Box 37
Westley

Sunflower Water
Lawrence D. Harrison, Secretary
Box 37
Westley

SUTTER COUNTY
Feather Water
Irving Pearce, Secretary
Box 647
Yuba City

Oswald Water
R. C. Thompson, Secretary
5383 Sawtelle Avenue
Yuba City

(Sutter County Cont'd)

South Sutter Water
Joseph H. Dewey, Secretary
Box 27
East Nicolaus

Sullivan Orchards Water
Marion F. Sullivan, Secretary
7327 Garden Highway
Yuba City

Sutter Extension Water
David Sakuth, Secretary
4525 Franklin Rd.
Yuba City

TEHAMA COUNTY
Corning Water
C. A. Stromeness, Secretary
1207 Solano Street
Corning

Elder Creek Water
Ben Teisseire, Secretary
1005 South Jackson Street
Red Bluff

Proberta Water
Agnes Mosser, Secretary
Rte. 2, Box 2666
Red Bluff

TULARE COUNTY
Angiola Water
Albert Armor, Secretary
Box 1832
Fresno 93717

Hope Water
Fred A. Strauss, Secretary
Box 87
Porterville 93258

Lewis Creek Water
W. C. Zimmerman, Secretary
Box 951
Lindsay

Tea Pot Dome Water
Marjorie M. Meier, Secretary
Rte. 4, Box 36
Porterville

VENTURA COUNTY
Ocean View Water
Jana L. Johnson, Secretary
Box 1368 - Ventura, Calif.

YOLO COUNTY
Dunnigan Water
Frank Lopez, Secretary
Box 28
Dunnigan

Yolo-Zamora Water
L. S. Foster, Treasurer
Box 387
Woodland

YUBA COUNTY
Dantoni Water
John B. Fitzgerald, Treasurer
423 - 4th Street
Marysville

Ramirez Water
Sam Zall, President
10674 Ramirez Road
Marysville

Wheatland Water
Mrs. Helen Stineman, Secretary
Box 404
Wheatland

List of FLOOD CONTROL & WATER CONSERVATION DISTRICTS as of June 30, 1964

ALAMEDA COUNTY

Alameda County Flood Control & Water
Conservation
Board of Supervisors

CONTRA COSTA COUNTY

Contra Costa County Flood Control & Water
Conservation
Board of Supervisors

DEL NORTE COUNTY

Del Norte County Flood Control
Board of Supervisors

FRESNO COUNTY

Fresno Metropolitan Flood Control
Robert Robertson, Sec.
830 Van Ness Ave.
Fresno 21

HUMBOLDT COUNTY

Humboldt County Flood Control
Board of Supervisors

LAKE COUNTY

Lake County Flood Control & Water
Conservation
W. Hansen, Sec.
Box 696
Lakeport

LASSEN COUNTY

Lassen-Modoc County Flood Control & Water
Conservation
Badene Wemple, Sec.
Courthouse
Susanville

LOS ANGELES COUNTY

Los Angeles County Flood Control
H. E. Salsbury, Chief Engr.
Box 2418 Terminal Annex
Los Angeles 54

MARIN COUNTY

Marin County Flood Control & Water
Conservation
Board of Supervisors

MENDOCINO COUNTY

Mendocino County Flood Control & Water
Conservation
Board of Supervisors

MENDOCINO COUNTY

Ukiah Flood Control
Harry Hopper, Pres.
Box 158 Talmage Calif.
Ukiah

MODOC COUNTY

Owl Creek Flood Control & Flood
Water Conservation
Edward B. Berryessa, Sec.
Eagleville

MONTEREY COUNTY

Monterey County Flood Control & Water
Conservation - Adm.
Board of Supervisors

NAPA COUNTY

Napa County Flood Control & Water
Conservation
Board of Supervisors

ORANGE COUNTY

Orange County Flood Control
Board of Supervisors

PLUMAS COUNTY

Plumas County Flood Control & Water
Conservation
Board of Supervisors

RIVERSIDE COUNTY
Riverside County Flood Control
4600 Crestmore Rd.
Riverside

SACRAMENTO COUNTY

American River Flood Control
Enoch E. Stewart, Sec.
907 - 5th St.
Sacramento

Morrison Creek Flood Control
Board of Supervisors

SAN BENITO COUNTY

San Benito County Water Conservation
and Flood Control

Board of Supervisors

SAN BERNARDINO COUNTY

San Bernardino County Flood Control
Board of Supervisors

SAN DIEGO COUNTY

San Diego Flood Control
Board of Supervisors

SAN JOAQUIN COUNTY

San Joaquin County Flood Control and
Water Conservation
Board of Supervisors

SAN LUIS OBISPO COUNTY

San Luis Obispo Flood Control & Water
conservation
943 Santa Rosa St.
San Luis Obispo

SAN MATEO COUNTY

San Mateo County Flood Control
Board of Supervisors

SANTA BARBARA COUNTY

Santa Barbara County Flood Control & Water
Conservation
Board of Supervisors

SANTA CLARA COUNTY

Santa Clara County Flood Control & Water
Conservation
Donald K. Currlin, Mgr.
70 W. Hedding
San Jose 10

SANTA CRUZ COUNTY

Santa Cruz County Flood Control & Wat
Conservation
Board of Supervisors

SIERRA COUNTY

Sierra County Flood Control & Water
Conservation
Board of Supervisors

SISKIYOU COUNTY

Siskiyou County Flood Control & Wate
Conservation
Board of Supervisors

SOLANO COUNTY

Solano County Flood Control & Water
Conservation
Larry Ball, Sec.
Board of Supervisors

SONOMA COUNTY

Cloverdale Flood Control
E. C. Emmons, Chm.
25300 Redwood Hwy.
Cloverdale

Dry Creek Flood Control
George D. Kahlke, Dir.
24 South University Ave.
Healdsburg

Sonoma County Flood Control & Water
Conservation
Board of Supervisors

TEHAMA COUNTY

Tehama County Flood Control & Water
Conservation
Floyd Hicks, Sec.
County Courthouse
Red Bluff

VENTURA COUNTY

Flood Control - Administration
Board of Supervisors

YOLO COUNTY

Yolo County Flood Control & Water Con
Joseph Griffin, Sec.
Woodland

List of COUNTY WATER DISTRICTS as of June 30, 1964

ALAMEDA COUNTY

Alameda County Water
Phyllis Kettring, Secretary
38050 Fremont Blvd.
Fremont

Cherryland County Water
O. F. Dennis, Secretary
21559 Banyan
Hayward,

Eden Township County Water
Claude T. Silva, Secretary
147 E. Lewelling Blvd.
San Lorenzo 94580

Fairview County Water
Joseph C. Pefferle, Secretary
4020 Meadowview Drive
Castro Valley

Pleasanton Township County Water
Warren M. Annis, Mgr.-Sec.
P. O. Box 70
Pleasanton

AMADOR COUNTY

Amador County Water No. 1
Inactive

Drytown County Water
Marian Randolph, Secretary
P. O. Box 36
Drytown

Pioneer-Pine Grove-Volcano County Water
Virginia L. Schwartz, Secretary
P. O. Box 156
Pine Grove

CALAVERAS COUNTY

Calaveras County Water
Paul E. Lewis, Secretary
P. O. Box 846
San Andreas 95249

COLUSA COUNTY

Colusa County Water
Alfonso R. Carrion, Secretary
Rte. 1, Box 35
Arbuckle

CONTRA COSTA

Castle Rock County Water
E. D. Orser, Secretary
800 Castle Rock Road
Walnut Creek

Contra Costa County Water
Mrs. Bertha M. McCloskey, Sec.
2020 Railroad Avenue
Pittsburg 94565

Oakley County Water
Leonard Celoni, Secretary
Box 397A Rt. 2
Oakley

Pleasant Hill County Water
M. H. Stanley, Secretary
P. O. Box 105
Lafayette

San Miguel Estates County Water
Harry A. Hilts, Jr., Sec.
375 La Casa Via
Walnut Creek

San Ramon Valley County Water
G. H. Warren, Jr., Pres.
2137 Blackwood Drive
Walnut Creek 94598

Southwest Contra Costa County Water
Jeanne M. Corr, Secretary
P. O. Box 1547
Richmond

Walnut County Water
Anne D. Boyer, Secretary
98 Greenway Drive
Walnut Creek

EL DORADO COUNTY

Diamond Springs County Water
Inactive

El Dorado Hills County Water
Harrison Call, Jr., Sec.
P. O. Box 88
El Dorado Hills

Southside County Water
E. H. Althoff, Sec.
Box 61
El Dorado

FRESNO COUNTY

Calwa County Water
W. R. Eppert, Secretary
2619 So. 10th Street
Fresno 93725

Free Water County Water
Maryellen Thompson, Sec.
1847 Jensen Avenue
Sanger

Laton County Water
Estle E. Stewart, Secretary
P. O. Box 441
Laton

Malaga County Water
Jack Selvian, Sec.
2439 So. Willow
Fresno 25

Pinedale County Water
Ann Rubio, Secretary
P. O. Box 629
Pinedale 93650

HUMBOLDT COUNTY

Alderpoint County Water
Eileen McRae, Secretary
Gen. Del.
Alderpoint

Hydesville County Water
Norman Solenberger, Sec.
P. O. Box 362
Hydesville

Rio Dell County Water
William M. Hunsaker, Secretary
P. O. Box 55
Scotia

Rohnerville-Campton Heights County Water
Helen Hicks, Secretary
P. O. Box 322
Fortuna

IMPERIAL COUNTY

Brawley County Water
Norma V. Smyth, Secretary
Rte. 1, Box 5H
Brawley

(Imperial County Cont'd)

Palo Verde County Water
D. C. Peck, Secretary
P. O. Box 25
Palo Verde

Seeley County Water
Ruth Laye, Secretary
Seeley

KERN COUNTY

Buttonwillow County Water
W. F. Schroeter, Sec.
P. O. Box 26
Buttonwillow

Greenfield County Water
Dalia Wilcox, Secretary
P. O. Box 86
Bakersfield

Ridgecrest County Water
Marge Daiber, Secretary
P. O. Box 426
Ridgecrest

West Kern County Water
Clarence Williams, Jr.
P. O. Box MM
Taft

KINGS COUNTY

Kings County Water
Gerald Schumacher, Secretary
616 W. 7th Street
Hanford

LAKE COUNTY

Clearlake Oaks County Water
Lee L. Argo, Secretary
P. O. Box 407
Clearlake Oaks

Konocti County Water
Mildred V. Crawford, Sec.
P. O. Box 997
Clearlake Highlands

Lake County Water
Earl Wrieden, Pres.
P. O. Box 696
Lakeport

LAKE COUNTY (Cont'd)

[illegible] County Water [illegible]
Harry Mortensen, Secretary
Box 633
Middletown

LASSEN COUNTY

Clear Creek Lassen County Water
Marietta Davis, Secretary
Box 11
Westwood

LOS ANGELES

Baldwin Park County Water
Ralph B. Helm, Secretary
14521 E. Ramona Blvd.
Baldwin Park 91706

Bellflower County Water
C. E. Clough, Secretary
16431 S. Bellflower Blvd.
Bellflower

[illegible] County Water
Roger Pryor, Pres.
411 So. Long Beach Blvd.
Compton

Crescenta Valley County Water
Mrs. [illegible] I. Byrd, Secretary
2904 Foothill Blvd.
La Crescenta

Gibson Park County Water
Ruby M. Greene, Auditor
14603 So. Orange Ave.
Paramount

La Puente Valley County Water
A. J. Roby, Secretary
15825 E. Main St.
La Puente

Newhall County Water
Helen L. Thompson, Secretary
P. O. Box 323
Newhall

Orchard Dale County Water
P. W. Meredith, Secretary
13819 E. Telegraph Rd.
Whittier

(L. S. County Cont'd)

Paramount County Water
C. F. Culver, Secretary
16430 Paramount Blvd.
Paramount

Pico County Water
Dora M. Moen, Secretary
4843 S. Church St.
Pico Rivera

Quartz Hill County Water
Rhea Schmitt, Secretary
P. O. Box 3218
Quartz Hill

Rowland Area County Water
Clarence E. Potratz, Secretary
P. O. Box O
La Puente

San Gabriel County Water
Lupie Peters, Secretary
P. O. Box 247
San Gabriel

Sativa-Los Angeles County Water
Pearl F. Meadows, Secretary
2015 E. Hatchway St.
Compton 4

Val Verde County Water
F. D. Godden, Secretary
1832 W. Washington Blvd.
Los Angeles,

MADERA COUNTY

North Fork County Water
Robert C. Quick, Chairman
P. O. Box 123
North Fork

MARIN COUNTY

North Marin County Water
E. S. Churchill, Secretary
P. O. Box 146
Novato

Stinson Beach County Water
Harriet M. Greene, Secretary
P. O. Box 245
Stinson Beach

MENDOCINO COUNTY

Calpella County Water
Kathryn Rici, Secretary
P. O. Box 115
Calpella

Elk County Water
Flora E. Buchanan, Secretary
Elk

Laytonville County Water
Diana Robinson, Secretary
Laytonville

Millview County Water
Betty L. Hopper, Secretary
Rte. 1, Box 706
Ukiah

North Mendocino County Water
George Carver, Director
Box 278
Leggett

Redwood Valley County Water
Ethel Jameson, Secretary
General Delivery
Redwood Valley 95470

Round Valley County Water
Alta F. Moore, Secretary
Covelo

Willow County Water
Violet Long, Secretary
150 Blue Bonnet Dr.
Ukiah 95482

MERCED COUNTY

Delhi County Water
Mrs Mildred Michalec, Sec.
Box 426
Delhi 95315

Franklin County Water
Betty Ferranti, Secretary
2126 N. Drake
Merced 95340

South Dos Palos County Water
Albert J. Cesario, Secretary
P. O. Box 278
South Dos Palos

MODOC COUNTY

Newell County Water
Robert L. Jones, Sec.
P. O. Box 458
Tulelake

Mammoth County Water
Ben Elliot, Secretary
Mammoth Lakes

MONTEREY COUNTY

Castroville County Water
Joseph X. Stone, Secretary
P. O. Box 658
Castroville

Marina County Water
Margaret Heldt, Secretary
Box 531
Pacific Grove

NAPA COUNTY

American Canyon County Water
Betty M. Custis, Secretary
110 Andrew Rd.
Vallejo

Circle Oaks County Water
Alma N. Fitch, Secretary
4721 Monticello Rd.
Napa

Congress Valley County Water
Merton Perry, Pres.
1041 Sunset Rd.
Napa

Yountville County Water
Verne Clark, Secretary
Mount Ave.
Yountville

NEVADA COUNTY

French Corral County Water
Mrs. Belle D. Wetzel, Sec.
Smartville

San Juan Ridge County Water
Frances Milhous, Sec.
Box 18
North San Juan

NEVADA COUNTY (Continued)

Washington County Water
Robert Slyter, Sec.
P. O. Box 35
Washington 95986

ORANGE COUNTY

Capistrano Beach County Water
John Serences, Secretary
Box 6A
Capistrano Beach

Costa Mesa County Water
Ray Wallace, Secretary
1971 Placentia Ave.
Costa Mesa

Cypress County Water
D. T. Mackey, Sec.
9471 Walker St.
Cypress

East Orange County Water
Alexander Bowie, Sec.
401 W. 8th St.
Santa Ana

Laguna Beach County Water
Bessie C. Briscoe, Sec.
Box 987
Laguna Beach

Los Alamitos County Water
Mrs. Marjorie Travers, Sec.
323 Katella Ave.
Los Alamitos

Santa Ana Mountains County Water
Alexander Bowie, Sec.
401 West 8th
Santa Ana

Santiago County Water
H. Rodger Howell, Sec.
401 W. 8th St.
Santa Ana

South Coast County Water
R. Smith, Secretary
Box A
South Laguna

(Orange County Cont'd)

Stanton County Water
Mildred Roeske, Sec.
P. O. Box 396
Stanton

Yorba Linda County Water
Valdo Y. Smith, Secretary
P. O. Box 469
Yorba Linda

PLACER COUNTY

Alpine Springs County Water
William D. vers, Sec.
Tahoe City

Applegate-Clipper Gap County Water
La Verne Suhar, Secretary
Placer Hills

Meadow Vista County Water
Olive Simpkins, Secretary
P. O. Box 163
Meadow Vista

Midway Heights County Water
Florentine Camenesch, Pres.
Colfax

Sheridan County Water
Mrs. Donna Freeman, Secretary
Box 138
Lincoln

Sierra Lakes County Water
Geraldine Simonds, Secretary
2129 Hacienda Way Suite J
Sacramento 95825

Squaw Valley County Water
Wayne E. Poulsen, Pres.
Drawer A
Olympic Valley

RIVERSIDE COUNTY

Cabazon County Water
Dorothea Callahan, Sec.
1249 Massachusetts
Beaumont

Coachella Valley County Water
Iris C. Kramer, Sec.
Box 1058 - Coachella

RIVERSIDE COUNTY (Cont'd)

Desert Hot Springs County Water
C. Shelton, Secretary
Box 197
Desert Hot Springs

East Blythe County Water
Robert A. Brockmeier, Sec.
Box 846
Blythe

Idyllwild County Water
Ada Morlan, Sec.
Box 397
Idyllwild 92349

Murrieta County Water
Carolyn Donaho, Dir.
Box 174
Murrieta

North Palm Springs County Water
Mrs. Genevra McCance, Sec.
Box 276
North Palm Springs

Pine Cove County Water
Vera G. Dews, Sec.
Box 222
Idyllwild 92349

SACRAMENTO COUNTY

Arcada County Water
Nancy Ross, Secretary
Box 214317
Sacramento 21

Del Paso Manor County Water
David M. Yorton, Sec.
4268 Lusk Drive
Sacramento 21

Florin County Water
David M. Yorton, Sec.
Box 214
Florin

Galt County Water
Orval Crosson, Sec.
Box 96
Galt

Northridge Park County Water
John Lemmon, Sec.
5331 Walnut Ave.
Sacramento 95841

SACRAMENTO COUNTY (Cont'd)

Rio Linda County Water
Henry Hl Wagner, Sec.
Box 401
Rio Linda

SAN BENITO COUNTY

Aromas County Water
William Codiga, Sec.
Box 323
Aromas

Sunnyslope County Water
Herbert W. Bengard, Sec.
1320 Hillcrest Rd.
Hollister

Tres Pinos County Water
Mrs. Pauline Gomes, Sec.
Box 529
Tres Pinos

SAN BERNARDINO COUNTY

Apple Valley Foothill County Water
Charlotte Thompson, Sec.
Box 914
Apple Valley

Apple Valley Heights County Water
Mrs. John Boyns, Sec.
Box 1076
Apple Valley

Arrowbear Park County Water
Frank R. Seccombe, Pres.
Arrowbear Lake

Crest Forest County Water
Burt H. Heiser, Sec.
Box 656
Crestline

Crestline Village County Water
Jeannette Haskell, Sec.
Drawer R
Crestline

Cucamonga County Water
Norman Hixson, Sec.
Box 176
Cucamonga

SAN BERNARDINO COUNTY (Cont'd)

Desert View County Water
Mary Lou Lewis, Secretary
Star Route No. 2, Box 2262
Yucca Valley

East San Bernardino County Water
Harold Rickert, Secretary
7337 Del Rosa Avenue
San Bernardino

Havasu Lake County Water
Warren L. Broad, Sec.
Box 1021
Havasu Lake

Joshua Basin County Water
Lucile C. Kerr, Sec.
Box 603
Joshua Tree, California

Mariana Ranchos County Water
Ann Holt, Sec.
9515 Sagebrush Road
Apple Valley

Mojave River County Water
Lloyd Lopp, Sec.
18656 Seneca Rd.
Apple Valley

Monte Vista County Water
William W. Coates, Sec.
10575 Central Ave.
Montclair

Palm Wells County Water
Mrs. Sally Coppersmith, Sec.
Box 341
Morongo Valley

Running Springs County Water
Helene Oly, Sec.
Running Springs

South San Bernardino County Water
Geneva Mantz, Secretary
10243 Tippecanoe
San Bernardino 92410

(San Bernardino County Cont'd)

Starvista County Water
Ruby H. Harrod, Sec.
Box 2500
Yucca Valley

Twentynine Palms County Water
Edna B. Frye, Sec.
6544 Adobe Rd.
Twentynine Palms

Victorville County Water
Mrs. Ann Brown, Sec.
15445 - 8th Street
Victorville

West San Bernardino County Water
Nicholas E. Presecan, Sec.
Box 186
Rialto

Yucca Valley County Water
Mrs. Mary Schroeder, Sec.
Box 599
Yucca Valley

SAN DIEGO COUNTY

Borrego Springs Park County Water
Robert G. Stewart, Secretary
Box 393
La Jolla

La Presa County Water
Minnie I. Turner, Secretary
10595 Jamacha Blvd.
Spring Valley

Leucadia County Water
Gene A. Uhrick, Sec.
Box 2561 R. R. No. 1
Encinitas

Pomerado County Water
Lillian Hartley, Sec.
12951 Pomerado Rd.
Poway

San Marcos County Water
Box 37 (Jeanne Gist, Sec.)
San Marcos 92069

SAN DIEGO COUNTY (Cont'd)

Santee County Water
Gerald Hardy, Secretary
Box 70
Santee

Tia Juana Valley County Water
Mrs. S. E. Berry, Sec.
Box 102
Nestor

SAN JOAQUIN COUNTY

Lathrop County Water
Olive McCormick, Sec.
Box 835
Lathrop

Linden County Water
Fred Strong, Secretary
Linden

SAN LUIS OBISPO COUNTY

Atascadero County Water
Dorothea L. Potter, Sec.
Box 651
Atascadero 93422

Baywood Park County Water
Mrs. B. Broderick, Sec.
8th & El Morro
Baywood Park 93401

Cambria County Water
Leon Bordegaray, Secretary
Box 65
Cambria 93428

Garden Farms County Water
Mrs. John Jordan, Sec.
16850 Walnut Ave.
Atascadero

Morro Del Mar County Water
Frank McAllister, Pres.
2760 Highway 1
Morro Bay

Shell Beach County Water
J. H. Duggan, Pres.
Box 1
Shell Beach

SAN MATEO COUNTY

Belmont County Water
C. E. Mussen, Sec.
Box 158
Belmont

Canada County Water
Ethel Lindauer, Sec.
156 University Ave.
Palo Alto

Coastside County Water
John H. Canadas, Mgr.
Box 455
Half Moon Bay

Los Trancos County Water
Margaret K. Churchon, Sec.
162 Los Trancos Circle
Menlo Park

North Coast County Water
Alice Filios, Sec.
Box 35
Pacifica

Skyline County Water
Jean Rodden, Secretary
14444 Skyline Blvd.
Redwood City

Westborough County Water
Joseph C. Caesar, Sec.
2698 Westborough Blvd.
South San Francisco

SANTA BARBARA COUNTY

Carpinteria County Water
Gayle M. Key, Sec.
Box 578
Carpinteria

Goleta County Water
D. P. Johnston, Sec.
Box 305
Goleta

Summerland County Water
Maynard Kirkwood, Sec.
Box 51
Summerland

SANTA CLARA COUNTY

Aldercroft Heights County Water
Mary Bellingtyne, Secretary
Box 161
Los Gatos

Cupertino-Fremont County Water
Inactive

Milpitas County Water
Bruce P. Griswold, Secretary
Box 65
Milpitas

Purissima Hills County Water
W. D. McCann, Secretary
Box 677
Los Altos

SANTA CRUZ COUNTY

Central Santa Cruz County Water
Mrs. Marilyn Lee, Secretary
Box 400 Cox Road
Aptos,

Lompico County Water
Marguerite Kitson, Sec.
Box 781
Felton

San Lorenzo Valley County Water
Mrs. Bernice Vorrath, Sec.
Box 385
Ben Lomond

Scotts Valley County Water
Mrs. Elmer L. Lewis, Secretary
5272B Scotts Valley Drive
Santa Cruz

Soquel Creek County Water
James A. Harris 3rd, Sec.
Box 158
Soquel

SHASTA COUNTY
Buckeye County Water
Lenna M. North, Sec.
Buckeye Rt. Box 2285
Redding 96001

(Shasta County Cont'd)

Burney County Water
Lucille von Tersch, Secretary
Box 647
Burney

Cottonwood County Water
L. H. Meyer, Secretary
Box 576
Cottonwood

SIERRA COUNTY

Alleghany County Water
Joseph Sbaffi, Pres.
Alleghany

SONOMA COUNTY

Forestville County Water
Genevieve Smith, Sec.
Box 261
Forestville 95436

Piner-Olivet County Water
Norman Nation, Sec.
3343 Piner Rd.
Santa Rosa

Sonoma Mountain County Water
Thomas Alpin, Secretary
2000 Crane Canyon
Santa Rosa

Valley of the Moon County Water
Alma Loyal, Secretary
Box 278
El Verano

Wikiup County Water
Cecil A. Kettle, Secretary
461-A Las Casitas
Santa Rosa

Windsor County Water
Elsie Landrus, Secretary
Box 353
Santa Rosa

STANISLAUS COUNTY

South Modesto County Water
Robert W. Williams, Pres.
1901 Crows Landing Rd.
Modesto

TULARE COUNTY

Nickerson County Water
Vincent Renzi, Secretary
3542 Fairview
Visalia

TUOLUMNE COUNTY

Tuolumne County Water No. 1
C. H. Otter, Secretary
Box 67
Twain Harte

Tuolumne County Water District No. 2
Harry S. Hinkley, Sec.
Box 1044
Sonora

VENTURA COUNTY

Camarillo County Water
Guy H. Turner, Sec.
182 Kenneth St.
Camarillo

Fairview County Water
J. Andy Water, Pres.
11003 Broadway
Moorpark

Meiner's Oaks County Water
Mrs. Margaret Beard, Sec.
202 El Robler Drive
Ojai

Oxnard Beach County Water
Grace Hoffman, Sec.
116 Oxnard Rd.
Oxnard 93032

Pleasant Valley County Water
A. R. Herron, Sec.
Box 608
Oxnard 93033

Ventura River County Water
Godfrey Jacobs, Sec.
Box 595
Ojai

YUBA COUNTY

Johnson Rancho County Water
Barbara Jean Boom, Sec.
Rte 1, Box 16
Wheatland

Linda County Water
Arlene F. Hafner, Sec.
124 Scales Ave.
Marysville

Yuba County Water
Gracie Whiteley, Sec.
Box 4
Brownsville

List of MUNICIPAL WATER DISTRICTS as of June 30, 1964

HUMBOLDT COUNTY

Humboldt Bay Municipal Water
A. J. Gosselin, Sec.
Box 95

KERN COUNTY

Bakersfield Municipal Water
Mrs. Lilas Svendson, Sec.
1107 Truxton Ave.
Bakersfield

LOS ANGELES COUNTY

Central Basin Municipal Water
Carl Fossette, Sec.
7439 E. Florence Ave.
Downey

Foothill Municipal Water District - Adm.
E. D. Richards, Sec.
4508 Hampton Road
La Canada

Huntington Municipal Water
Norman L. MacLeod, Jr., Sec.
801 Madre St.
Pasadena

Las Virgenes Municipal Water
William M. Bray, Sec.
4232 Las Virgenes Rd.
Calabasas, California 91302

Pomona Valley Municipal Water
E. P. Carrey, Sec.
146 E. 3rd St.
Pomona

San Gabriel Valley Municipal Water
Boyd Kern, Sec.
Box 428
Alhambra

Upper San Gabriel Valley Municipal Water
Carl Fossette, Gen. Mgr.
407 E. Valley Blvd.
El Monte

West Basin Municipal Water
W. R. Selby, Sec.
303 Garnet St.
Redondo Beach

MARIN COUNTY

Marin Municipal Water
B. J. Brusatori, Sec.
220 Nellen Ave.
Corte Madera

Novato Municipal Water
Inactive

MONTEREY COUNTY

Monterey Peninsula Municipal Water
Myron B. Haas, Sec.
Seaside Professional Bldg. Fremont Blvd.
Seaside 93955

ORANGE COUNTY

Coastal Municipal Water
E. H. Beaver, Treas.
Box 913
Laguna Beach

Orange County Municipal Water
Thomas S. Maddock, Sec.
Box 1982
Santa Ana

Tri-Cities Municipal Water
Dora H. Anderson
Box 416
San Clemente

RIVERSIDE COUNTY

Eastern Municipal Water
Ruth E. Norton, Sec.
Box 248
Hemet 92343

Elsinore Valley Municipal Water
John G. Baer, Sec.
16-755 Grand Ave.
Elsinore

Lake Hemet Municipal Water
Theodore H. Eggen, Sec.
Box 97
Hemet

Western Municipal Water
Everett L. Grubb, Sec.
Box 2038
Riverside

SAN BERNARDINO COUNTY

Big Bear Municipal Water
Darrell Altimus, Sec.
Box 946
Big Bear Lake 92315

Chino Basin Municipal Water
E. L. Keechler, Sec.
Box 697
Cucamonga 91730

San Bernardino Valley Municipal Water
Horace P. Hinckley, Sec.
Box 1144
San Bernardino 92402

SAN DIEGO COUNTY

Bueno Colorado Municipal Water
W. W. Miller, Sec.
Box 1137
Vista

Carlsbad Municipal Water
Richard Coe, Sec.
5780 El Camino Real
Carlsbad

Dehesa Valley Municipal Water
Mrs. Robert Caraway, Sec.
1863 Harbinson Canyon Rd.
El Cajon 92021

De Luz Heights Municipal Water
Dorothy Gillett, Sec.
Box 663
Fallbrook

Encinitas Municipal Water
R. L. Blickenstaff, Sec.
Box 488
Encinitas

Kentwood In The Pines Municipal Water
702 Civic Center
San Diego 92101

Mootamai Municipal Water
Ronald A. Davidson, Sec.
R. Bradley, Pres.
Pauma Valley

Olivenhain Municipal Water
Maurice G. Smith, Atty.
Box 517
Encinitas, 92024

SAN DIEGO Cont'd)

Otay Municipal Water
Harry T. Baker, Sec.
10595 Jamacha Blvd.
Springs Valley

Pauma Municipal Water
Adelaide McCormick,
Pauma Valley

Poway Municipal Water
Lawrence R. Smith, Sec.
12316 Oak Knoll Rd.
Poway

Questhaven Municipal Water
Esther Gardner, Sec.
Box 1628
Escondido

Rainbow Municipal Water
Edward Anderson, Exec. Sec.
124 South Main
Fallbrook

Ramona Municipal Water
Fred W. Hanssler, Sec.
202 - 6th St.
Ramona

Rincon Del Diablo Municipal Water
Loren R. Sisson, Sec.
634 W. 5th Avenue
Escondido

Rio San Diego Municipal Water
Alex Adams, Sec.
Box 656
Lakeside

San Luis Rey Municipal Water
Robert L. Pankey, Pres.
Pankey Ranch
Bonsall

Valley Center Municipal Water
Charles C. Becker, Sec.
Box 654, Rte 4
Valley Center

Whispering Pines Municipal Water
Edward C. Davis, Sec.
420 San Diego Trust & Savings Bldg.
San Diego 92101

SAN DIEGO COUNTY (Contd)

Yuima Municipal Water
Samuel Y. Pitts, Sec.
Box 177
Pauma Valley

VENTURA COUNTY

Anacapa Municipal Water
Edward C. Maxwell, Sec.
5701 Gonzales Rd.
Oxnard

Calleguas Municipal Water
Monroe Everett, Sec.
Box E
Somis 93066

Colonia Municipal Water
Ralph W. Borchard, Sec.
5701 W. Gonzales Rd.
Oxnard

Del Norte Municipal Water
Edwin B. Shriner, Sec.
Box 1797
Ventura

Hidden Valley Municipal Water
Earl G. Stallsworth, Sec.
Rte. 1, Box 40
Thousand Oaks

Ocean View Municipal Water
Dana L. Johnson, Sec.
Box 1368
Ventura

Pleasant Valley Municipal Water
Patricia P. Broome, Sec.
Box 608
Oxnard

Russell Valley Municipal Water
Mrs. Eileen Burnett, Sec.
Rt. 1, Box 682
Thousand Oaks

Ventura River Municipal Water
Dr. J. S. Flynn, Sec.
1055 Ventura Ave.
Oak View

List of COUNTY WATERWORKS DISTRICTS as of June 30, 1964

COLUSA COUNTY

Princeton Waterworks
John Miles, Secretary
Princeton

Colusa County Waterworks No. 1
Almon Sutliff, Secretary
Colusa

CONTRA COSTA COUNTY

Contra Costa County Waterworks No. 1
Al Markus
Box 402
Brentwood

FRESNO COUNTY

Fresno County Waterworks No. 1
Carl Gronlund, Manager
216 Equitable Bldg.
Fresno

Fresno Waterworks No. 2
Carl Gronlund, Manager
1221 Fulton Street
Fresno

Fresno Waterworks No. 3
Mrs. Bernice Van Patten, Secretary
1721 Orchard Street
Fresno 3

Fresno County Waterworks No. 4
County Auditor

Fresno County Waterworks No. 5
Carl Gronlund, Manager
216 Equitable Bldg.
Fresno

Fresno Waterworks No. 6
Val M. Francis, Manager
4540 E. Robinson
Fresno

Fresno County Waterworks No. 7
Carl J. Gronlund, Manager
1221 Fulton
Fresno

Fresno Waterworks No. 8
Carl Gronlund, Manager
216 Equitable Bldg.
Fresno

Fresno Waterworks No. 9
J. L. Jones, Manager
2045 Ashlan Avenue
Fresno

Fresno County Waterworks No. 10
Carl J. Gronlund, Manager
1221 Fulton
Fresno

Fresno Waterworks No. 11
Ross N. Edelbrook, Manager
420 E. Keats
Fresno

Fresno Waterworks No. 12
F. K. Anderson, Manager
2619 South 10th
Fresno

Fresno Waterworks No. 13
F. K. Anderson, Manager
2619 South 10th Street
Fresno

Fresno County Waterworks No. 14
F. K. Anderson, Manager
2619 South 10th Street
Fresno

Fresno County Waterworks No. 15
F. K. Anderson, Manager
2619 South 10th Street
Fresno

Fresno County Waterworks No. 16
Frank Salontay, Jr., Exec-Mgr.
1337 E. Indianapolis Street
Fresno

Fresno County Waterworks No. 17
Carl Gronlund, Manager
216 Equitable Bldg.
Fresno

Fresno County Waterworks No. 18
N. L. Herboldshimer, Mgr.
Box 92
Friant

Fresno County Waterworks No. 19
Carl J. Gronlund, Ex. Mgr.
216 Equitable Bldg.
Fresno

County Waterworks No. 20
Eugene Lense, Mgr.
4574 E. Yale
Fresno

FRESNO COUNTY(Cont'd)

Fresno County Waterworks No. 21
Carl Gronlund, Mgr.
216 Equitable Bldg.
Fresno

Fresno County Waterworks No. 22
County Auditor

County Waterworks No. 23
Carl Gronlund, Mgr.
216 Equitable Bldg.
Fresno

County Waterworks No. 24
F. K. Anderson, Mgr.
2619 South 10th Street
Fresno

Fresno County Waterworks No. 25
Carl Gronlund, Mgr.
216 Equitable Bldg.
Fresno

Fresno County Waterworks No. 26
H. W. Jorgensen & Associates
322 North Moroa
Fresno

Fresno County Waterworks No. 27
Carl Gronlund, Ex. Mgr.
216 Equitable Bldg.
Fresno

Fresno County Waterworks No. 28
Carl J. Gronlund, Ex. Mgr.
216 Equitable Bldg.
Fresno

Fresno County Waterworks No. 29
F. K. Anderson, Ex. Mgr.
2619 South 10th Street
Fresno

Fresno County Waterworks No. 32
County Auditor

Fresno County Waterworks No. 34
County Auditor

Fresno County Waterworks No. 36
County Auditor

Fresno County Waterworks No. 37
County Auditor

LAKE COUNTY

Kelseyville County Waterworks No. 3
W. C. Ungewitter, Secretary
Kelseyville

Lower Lake County Waterworks No. 1
S. W. Hancher, Secretary
Lower Lake

Manakee County Waterworks
E. W. Scheiber, Secretary
Box 232
Clearlake Highlands

Middletown County Waterworks No. 5
County Auditor

LASSEN COUNTY

Lassen County Waterworks No. 1
Edison Lakey, Secretary
Bieber

LOS ANGELES

County Waterworks No. 1
County Auditor

County Waterworks No. 4
County Auditor

County Waterworks No. 10
County Auditor

County Waterworks No. 13
County Auditor

County Waterworks No. 16
County Auditor

County Waterworks No. 21
County Auditor

County Waterworks No. 22
County Auditor

County Waterworks No. 24
County Auditor

County Waterworks No. 26
County Auditor

County Waterworks No. 27
County Auditor

County Waterworks No. 29 (Malibu)
County Auditor

LOS ANGELES COUNTY

County Waterworks No. 31
County Auditor

County Waterworks No. 33
County Auditor

County Waterworks No. 34
County Auditor

County Waterworks No. 35
County Auditor

County Waterworks No. 36
County Auditor

County Waterworks No. 37
County Auditor

MADERA COUNTY

County Waterworks No. 1
County Auditor

MENDOCINO COUNTY

County Waterworks No. 1
County Auditor

County Waterworks No. 2 (Anchor Bay)
County Auditor

ORANGE COUNTY

County Waterworks No. 4
County Auditor

County Waterworks No. 5
County Auditor

County Waterworks No. 8
County Auditor

PLACER COUNTY

County Waterworks No. 1
County Auditor

SAN BERNARDINO COUNTY

County Waterworks No. 8
County Auditor

SAN JOAQUIN COUNTY

County Waterworks No. 1
Cap Anderson, Secretary
Victor

(San Joaquin County Cont'd)

County Waterworks No. 2
Reuben Rott, Attorney
228 West Pine
Lodi

SAN LUIS OBISPO COUNTY

County Waterworks No. 1
County Auditor

County Waterworks No. 2
County Auditor

County Waterworks No. 5
County Auditor

County Waterworks No. 6
County Auditor

County Waterworks No. 7
County Auditor

County Waterworks No. 8
County Auditor

SAN MATEO COUNTY

East Palo Alto County Waterworks
County Auditor

San Mateo County Waterworks No. 3
750 Industrial Road
San Carlos

SANTA CRUZ COUNTY

County Waterworks No. 1
County Auditor

SIERRA COUNTY

County Waterworks No. 1 (Calpine)
Raymond Fulz, President
Sattley

TRINITY COUNTY

County Waterworks No. 1
Malcolm Baldwin, Secretary
Hayfork

TULARE COUNTY

County Waterworks No. 1
Mrs. H. A. Douglas, Secretary
Box 1
Alpaugh

METROPOLITAN WATER DISTRICTS OF CALIFORNIA AS OF JUNE 30, 1964

Los Angeles County

Metropolitan Water District of Southern California
George M. Carroll, Controller
P. O. Box 54153
Los Angeles, California
90054

List of WATER STORAGE DISTRICTS as of June 30, 1964

FRESNO COUNTY
Westplains Water Storage
Price Giffen, Secretary
Box 4006
Fresno 93744

KERN COUNTY
Arvin-Edison Water Storage
C. B. Dickey, Secretary
1107 Truxton Av., c/o Francis Moore, Jr.,
Bakersfield

Belridge Water
Herschel Graves, Secretary
2901 H Street
Bakersfield

Buena Vista Water Storage
Gino Torigiani, Secretary
Box 756
Buttonwillow

North Kern Water Storage
Jane Mathews, Secretary
Box 1195
Bakersfield

Rosedale-Rio Bravo Water Storage
Alfred L. Bussell, Secretary
2714 L Street, Box 1508
Bakersfield

Semitropic Water Storage
Allen Bottorff, Secretary
2714 L Street
Bakersfield

Wheeler Ridge-Maricopa Water Storage
Oran W. Palmer, Secretary
2714 L Street
Bakersfield

KINGS COUNTY
Tulare Lake Basin Water Storage
James G. McCain, Secretary
Box 415
Corcoran

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

◆

IRRIGATION AND WATER STORAGE DISTRICTS
1964

"DIRECTORY OF CALIFORNIA IRRIGATION AND WATER STORAGE DISTRICTS" (listed alphabetically not by County)

[redacted] OF CALIFORNIA [redacted]

Calendar Year 1963

Name of district	County	Estimated population: Inside cities and towns	Estimated population: Outside cities and towns	Estimated population: Total	District officials: President	District officials: Secretary	District officials: Attorneys	District officials: Manager or engineer	District officials: District office address
Alpaugh	Tulare	600	600	1,200	Glenn C. Marshall	Irene McKee	Leroy McCormick	D. Keith Clotfelter (M&E)	Alpaugh, P. O. Box 127
Alta	Fresno, Tulare, Kings	15,000	10,000	25,000	William P. Boone	Anne M. Martsen	J. Thomas Crowe	J. A. Crawford (M)	Dinuba, 289 North L Street
Anderson-Cottonwood	Shasta, Tehama	9,000	6,500	15,500	Walter E. McCabe	Robert S. Caton	Minasian & Minasian	Robert S. Caton (M)	Anderson, 2810 Silver Street
Banta-Carbona	San Joaquin	—	1,500	1,500	Edgar R. Thoming	Elvera Draper	Jacobs, Cavalero, Dietrict, Bray	J. Allen Hall (M&E)	Tracy, P. O. Box 299
Bard	Imperial	—	500	500	P. C. Beasley	Caroline B. Winder	—	—	Bard, P. O. Box 4
Beaumont	Riverside	5,745	2,913	8,658	James L. Walker	Margaret I. Olson	James M. Worts	Elmer R. Joslin (M)	Beaumont, 560 Magnolia
Big Springs	Siskiyou	—	120	120	Anthony Machado	Mark M. Brawman	Mark M. Brawman	B. A. Maddox (M)	Yreka, 210 Fourth Street
Big Valley*	Lassen	1,250	320	1,570	E. G. Babcock	D. J. Leventon	James E. Pardee	William R. Giannelli (E)	Bieber, Box Y-3
Browns Valley	Yuba	• 1,000	• 2,000	• 3,000	Charles M. Davis	Billie G. Burris	Kronick, Moskovitz & Vanderlaan	C. E. Mageres (M)	Browns Valley, P. O. Box 6
Butte Valley	Siskiyou	125	200	325	James Butler	Lenore C. Brock	George A. Tebbe	Walter Keele (M)	Macdoel, P. O. Box 85
Byron-Bethany	Alameda, Contra Costa, S. J.	625	2,000	2,625	M. R. Furtado	Ruth Santos	Minasian & Minasian	W. L. Duncan (M)	Byron, P. O. Box 273
Camp Far West	Placer	—	—	—	Wm. Waggershauser	Benton Sedient	Martin McDonough	Clinton Rexney	Wheatland, P. O. Box 308
Carmichael	Sacramento	• 25,000	—	• 25,000	William L. Wagner	Thomas H. Underwood	Archie Hefner	Thomas H. Underwood (M&E)	Carmichael, 7001 Fair Oaks Blvd.
Carpenter	Orange	5,500	1,000	6,500	Donald L. Sexton	Melvin R. Clement	Rutan & Tucker	Jens N. Odgaard (M)	Orange, 18741 E. Center
Central California	Fresno, Merced, Stanislaus	17,000	20,000	37,000	Harry C. Fawcett	C. W. Bates	C. Ray Robinson	William Harnoff (M)	Los Banos, 830 Sixth Street
Citrus Heights	Sacramento	—	19,000	19,000	James Neal Brown	Dagney F. Prowell	William A. Sitton	Howard A. Nye (M)	Citrus Heights, 6230 Sylvan Road
Consolidated	Fresno, Tulare, Kings	25,000	30,000	55,000	Kirby W. Hansen	Seth T. Staire	William Miles	J. C. Bishop (M)	Selma, 1723 Tucker Street
Corcoran	Kings	5,100	5,000	10,100	W. F. Turner	S. S. Whitehead	James K. Abercrombie	M. J. Gallagher (M)	Corcoran, P. O. Box 506
Cordua	Yuba	—	1,000	1,000	C. E. Kitbe	Jeannette Franx	Rich, Fuidge, Dawson & Marsh	Oscar Jones (M)	Marysville, P. O. Box 264
Deer Creek	Tehama	—	60	60	Albert Clark	Jerome D. Peters, Jr.	Jerome D. Peters, Jr.	—	Chico, 414 Salem Street
Delano-Earlimart	Tulare, Kern	Not Reported		—	F. K. Nelson	John L. Pritchett	James K. Abercrombie	Samuel C. Fortier (M&E)	Delano, Route 1, Box 960
Ducor	Tulare	Not Reported		—	Paul Gerdes	Sara R. Parsons	Leroy McCormick	Fred Strauss (E)	Ducor, P. O. Box 73
Durham	Butte	1,240	—	1,240	Walter B. Wageman	Emmett A. Coon	F. J. Minasian	Emmett A. Coon (M)	Durham, Durham Street
East Contra Costa	Contra Costa	3,500	2,500	6,000	Charles R. Weeks	Margaret Davis	George Basye	Carroll B. O'Brien (M)	Brentwood, 626 First Street
El Camino	Tehama	—	1,050	1,050	John Deming	Rita M. Knox	L. C. Smith	E. T. Williams (M)	Gerber, Route 1, Box 390
El Dorado	El Dorado	13,700	1,400	15,100	H. V. Jaspersen	Harry J. Dunlop	George B. Maul	Harry J. Dunlop (M)	Placerville, 152 W. Washington St.
Elk Grove	Sacramento	Not Reported		—	Milon L. Johnston	Flora L. Doyle	—	—	Elk Grove, 8839 Elk Grove Blvd.
El Nido	Merced	Not Reported		—	Thomas S. Taft	Hugh H. Griswold	Hugh H. Griswold	Kenneth B. McSwain (E)	El Nido, P. O. Box 64
Empire West Side	Kings	—	110	110	Stanley L. Newton	C. S. Follett	Charles W. Jennings	George P. Clarke (M)	Lemoore 93245, 311 D Street
Exeter	Tulare	4,500	1,300	5,800	L. L. Swearingen	Floyde E. Brown	James K. Abercrombie	Floyde E. Brown (M)	Exeter, 150 South E. Street
Fair Oaks	Sacramento	—	—	• 28,000	Walter E. Waters	Margaret J. Clements	Phillip F. Driver	R. A. Briggs (M)	Fair Oaks, 10143 Fair Oaks Blvd.
Fresno	Fresno	—	—	—	John Ventura	Florence B. Carter	Walter H. Stammer	Paul H. Williamson (M)	Fresno, 1568 North Millbrook
Galt	Sacramento	—	—	—	Robert Smith	Gustav Gerling	Frank K. Richardson	—	Herald, P. O. Box 137
Glenn-Colusa	Colusa, Glenn	1,200	2,250	3,450	Seymour J. Vann	Paul M. Darnell	Minasian & Minasian	Clifford L. Brown (M)	Willows, 344 E. Laurel Street
Grenada	Siskiyou	—	220	220	Hollis H. Phillips	Mark M. Brawman	Mark M. Brawman	Frank Bortolazzo (M)	Yreka, 210 Fourth Street
Helix	San Diego	—	—	156,930	Harry C. Griffen	Margret C. Perry	W. F. Jennings	Byron H. Miller (M)	La Mesa, 8111 University Avenue
Hills Valley*	Fresno, Tulare	—	—	—	Ennis Hackett	Marion Long	Everett Harris	—	Orange Cove, 24473 E. American
Hot Springs Valley	Modoc	—	130	130	Fred Lybarger	W. E. Wallis	D. B. Robnett	John Kelley (M)	Alturas, 619 N. Main
Imperial	Imperial	—	—	83,520	Lon Thompson	J. L. Peabody	R. L. Knox, Jr.	Robert F. Carter (M)	El Centro, 590 State Street
Ivanhoe	Tulare	—	500	500	Edward R. Thomas	Howard Weekly	Crowe, Mitchell, Hurlbutt & Clevenger	Howard Weekly (M)	Visalia, 33777 Road 164
Jackson Valley	Amador	—	—	—	Clarence Scully	Henry Willy	Adolph Moskovitz	Henry Willy (M)	Ione, P. O. Box 205
James	Fresno	1,000	1,000	2,000	Harold Hale	Ina A. Wright	Richard L. Shepard	Robert L. Kent (M)	San Joaquin, P. O. Box 757
Kings River Delta*	Kings	—	—	—	George A. Smith, Jr.	—	—	—	Paso Robles, 145 Fairview Lane
Kinneloa	Los Angeles	—	560	560	Laurence A. Dietwel	Gilbert C. McCann, Jr.	J. Clifford Argue	B. Neal Batterson (M)	Pasadena, 1127 E. Doyne Road
La Canada	Los Angeles	—	—	7,272	J. Clifford Argue	Frank Mavin	Flint & MacKay	Frank Mavin (M)	La Canada, 1443 Foothill Blvd.
Laguna	Fresno, Kings	20,000	1,000	21,000	O. H. Kuckenbaker	Ruth Montgomery	Charles W. Jennings	Frank A. Coelho (M)	Riverdale, 5065 19½ Avenue
Lakeside	San Diego	—	—	4,515	Arthur L. Foster	H. P. Schiller	John P. Campbell	H. P. Schiller (M)	Lakeside, P. O. Box 638
Lemoore*	Kings	5,000	4,000	9,000	Maurice H. Hotchkiss	T. A. Bettencourt	Charles W. Jennings	—	Lemoore, P. O. Box 667
Linden*	San Joaquin	—	—	—	C. C. Anderson	Ralph G. Houston	Fred B. Lemmon	—	Linden, P. O. Box 585
Lindmore*	Tulare	—	3,600	3,600	Frank Hill	Evelyn Haynes	Robert E. Moock	R. L. Lenning (M)	Lindsay, P. O. Box 995
Lindsay-Strathmore	Tulare	219	2,998	3,217	Dick Moore	W. C. Zimmerman	McCormick, Moock & McCormick	Donald F. Burr (M)	Lindsay, P. O. Box 1805
Littlerock Creek	Los Angeles	1,400	—	1,400	O. B. Hermle	Willis Young	—	—	Littlerock, 35146 N. 82nd St.
Lower Tule River	Tulare	—	• 3,600	• 3,600	Anton Simonich	Frances M. Doyal	Kenneth A. Kuney	Richard L. Schafer (M)	Porterville, P. O. Box 511
Lucerne*	Kings	—	—	—	W. L. Haag	S. H. Hailsback	—	—	Hanford, Box 130, c/o Last Chance Ditch Co.
Madera	Madera	15,000	6,100	21,100	John A. Franchi	Frederick O. Bandy	Peckinpah, Pryor & Karr	Frederick O. Bandy (M)	Madera, P. O. Box 217
Maxwell	Colusa	—	50	50	Leo A. Yates	Marjorie R. Yates	Ralph W. Rutledge	Leo A. Yates (M)	Colusa, P. O. Box 152
Mendota*	Fresno	—	—	—	—	—	—	—	—
Merced	Merced	35,100	6,000	41,100	W. O. Sheesley	Carl T. Christianson	C. Ray Robinson	Kenneth R. McSwain (M&E)	Merced, 2423 L Street
Modesto	Stanislaus	42,300	34,100	76,400	Richard E. Penney	H. L. Brooks	Warren P. Gant	C. E. Plummer (E)	Modesto, 1231 11th Street
Mokelumne River	San Joaquin	—	—	—	Niel C. Locke	Tom H. Louttit	Tom H. Louttit	—	Stockton, 906 California Bldg.

o Inactive
• Estimated

(M) Manager
(E) Engineer

SOURCE: Bulletin 21-63, "Irrigation and Water Storage Districts in California: 1963", State of California, D. W. R., October, 1964.

"DIRECTORY OF CALIFORNIA IRRIGATION AND WATER STORAGE DISTRICTS" (listed alphabetically not by County)

TABLE III (continued)

DIRECTORY OF CALIFORNIA IRRIGATION AND WATER STORAGE DISTRICTS

Calendar Year 1963

Name of district	County	Estimated population			District officials				
		Inside cities and towns	Outside cities and towns	Total	President	Secretary	Attorneys	Manager or engineer	District office address
Montague Water Conservation	Siskiyou	840	265	1,105	Victor C. Stuart	Doris Goertz	Tebbe, Correia & Kleaver	Stanley W. Wendt (M)	Montague, P. O. Box 247
Nagles-Burk	San Joaquin	Not Reported			Alfred C. Ornellas	Alfred A. Souza	Alfred A. Souza	———	Tracy, 112 W. 10th Street
Nevada	Nevada, Placer	8,000	11,000	19,000	Warren S. Wilson	H. Georgia Scobie	Minasian & Minasian	Edwin Koster (M)	Grass Valley, 144 S. Auburn Street
Oakdale	Stanislaus, San Joaquin	8,750	10,250	19,000	Victor O. Wedegaertner	C. W. Quinley	P. J. Minasian	A. C. Holbrook (M)	Oakdale, 322 East D Street
Orange Cove	Fresno, Tulare	3,100	1,900	5,000	Harvey S. Chase	A. J. Vortmann	Leroy McCormick	A. J. Vortmann (M)	Orange Cove, P. O. Box 308
Oroville-Wyandotte	Butte	8,335	13,440	21,775	J. H. Pank	Charles H. Hauser	Minasian & Minasian	J. C. Woods (M)	Oroville, Old Quincy Road
Palmdale	Los Angeles	17,000	—	17,000	Dr. James J. Sloan	Dr. Francis H. Bourne	Ross W. Amspoker	Lowell W. Felt (M&E)	Palmdale, 2005 East Q Street
Palm Ranch	Los Angeles	—	2,600	2,600	Otis P. Dyar	Josephine Reeslund	Stanley B. Lagerlof	John L. Hilgendorf (M)	Quartz Hill, 4827 West Avenue L-2
Palo Verde	Riverside, Imperial	7,100	8,500	15,600	Bruce Kratka	L. S. Shipley	Roy Mann	John E. Blakemore (M)	Blythe, P. O. Box 38
Paradise	Butte	14,000	—	14,000	John L. Bisher, Jr.	Lorena Richardson	Minasian & Minasian	William B. Steele (M&E)	Paradise, 759 Birch Street
Pixley	Tulare	1,500	2,800	4,300	J. W. White	Helen M. Tompson	Kenneth A. Kuney	W. A. Alexander (M&E)	Pixley, P. O. Box 477
Porterville	Tulare	—	1,500	1,500	Guido Lombardi	Walter A. Groshong	Erling Kloster	Walter A. Groshong (M)	Porterville, P. O. Box 1248
Potter Valley	Mendocino	150	100	250	J. Cedric Thornton	E. C. Pauli	Leo M. Cook	Erwin Wipf (M)	Potter Valley, Main Street
Princeton-Codora-Glenn	Colusa, Glenn	400	800	1,200	L. C. Huffmaster	Clyde H. Lariner	Clyde H. Lariner	Ray L. Olson (M)	Princeton, P. O. Box 98
Provident	Colusa, Glenn	—	50	50	Walter Michael	T. E. Balch	Minasian & Minasian	T. E. Balch (M)	Willows, 136 S. Butte Street
Ramona	San Diego	5,360	—	5,360	Ray West	Johan O. Mitchell	W. H. Jennings	Elbert H. Ritchie (M)	Ramona, 202 Sixth Street
Richvale	Butte	250	100	350	Glenn R. Harris	Alvin L. Harry	Minasian & Minasian	Alvin L. Harry (M)	Richvale, P. O. Box 147
Riverdale	Fresno	3,000	2,000	5,000	———	Lucille Lawton	Charles W. Jennings	Orval Rhodes (M)	Riverdale, P. O. Box 683
San Dieguito	San Diego	—	—	18,688	Truman J. Petsold	Dorothy G. West	John M. Cranston	Charles M. Bonser (M&E)	Encinitas, 59 East D Street
Santa Fe	San Diego	—	8,500	8,500	R. E. Badger	Ralph M. Haney	John M. Cranston	Ralph M. Haney (M)	Rancho Santa Fe, P. O. Box 409
Saucelito	Tulare	—	450	450	Robert O. McCloskey	Daisy J. Hudson	Leroy McCormick	Daisy J. Hudson (M)	Porterville, 20712 Avenue 120
Scott Valley	Siskiyou	—	130	130	Frank H. Bryan	Richard M. Berry	Tebbe, Correia & Kleaver	P. R. Hughes (M)	Fort Jones, P. O. Box 8
Serrano	Orange	1,400	—	1,400	J. B. Holditch	P. H. Collins	Rutan & Associates	N. H. Wilson (M)	Orange, 18021 E. Lincoln
Shafter-Wasco	Kern	14,450	23,500	37,950	John J. Peters, Jr.	Robert C. Dilts	J. Thomas Crowe	Robert C. Dilts (M)	Wasco, P. O. Box 158
Solano	Solano	—	1,950	1,950	W. Morris Dally	James E. Wiggins	Leo C. Dunnell	Joseph C. Smith (E)	Vacaville, P. O. Box 536
South Bay	San Diego	—	—	—	Lloyd L. Lee	Walter R. Carey	Paul D. Engstrand, Jr.	Walter R. Carey (M)	Chula Vista, 371 E Street
South Fork	Modoc	—	125	125	Masten Ramsey	M. E. Walls	———	R. W. Wickenden (E)	Alturas, 619 N. Main Street
South Montebello	Los Angeles	8,500	—	8,500	Carl M. Cummings	Patricia D. Sinclair	Robert F. Hardesty	Blair J. Clancy (M)	Montebello, 864 W. Washington Blvd.
South San Joaquin	San Joaquin	16,000	11,000	27,000	M. F. Simas	Alice V. Hill	Jacobs, Cavallero, Deitrich & Bray	E. J. Johnson (E)	Manteca, 220 N. Main Street
Stinson	Fresno	10	25	35	William H. Noble	Robert L. Smith	———	———	Kerman, P. O. Box 641
Stone Corral	Tulare	—	150	150	Gordon H. Garland	E. D. Price	E. D. Price	Clyde Snow (M)	Visalia, 37656 Road 172
Stratford	Kings	250	750	1,000	Mike Dufur	Wanda Short	C. W. Jennings	George Clark (M)	Stratford, 20334 4th Street
Table Mountain	Butte	—	23	23	Margaret B. Chaffin	George R. Chaffin	———	A. L. Chaffin (M)	Oroville, Route 1, Box 153
Terra Bella	Tulare	950	800	1,750	Ralph Tyrrell	Frank J. Remerowski	James K. Abercrombie	Clifford E. Trotter, Jr. (M)	Terra Bella, P. O. Box 176
Thermalito	Butte	5,300	0	5,300	Bert K. Dally	F. Bentley Brownell	Minasian & Minasian	F. Bentley Brownell (M)	Oroville, 1985 4th Street
Tranquillity	Fresno	750	750	1,500	William E. Clotz	Iva Johnson	Claud L. Rowe	Albert Keith Miller (M)	Tranquillity, P. O. Box 277
Tulare	Tulare	14,500	5,000	19,500	H. H. Sisson	David L. Zack	Kenneth A. Kuney	L. E. Robertson (M)	Tulare, P. O. Box 163
Tule	Lassen	0	0	0	Loren E. Blakeley	Lois B. Blakeley	Alfred H. Stoloff	Loren E. Blakeley (E)	Anaheim, 125 S. Claudina Street
Tulelake	Modoc, Siskiyou	1,200	1,400	2,600	Sam Anderson	Edwin V. Lance	Alvin Landis	Edwin V. Lance (M)	Tulelake, P.O. Box 787
Turlock	Stanislaus, Merced	—	—	71,440	A. M. Crowell	R. S. Tillner	Jeremy C. Cook	R. V. Meikle (E)	Turlock, 333 East Canal Drive
Vandalia	Tulare	—	144	144	John H. O. Emery	Marjorie M. Meier	James K. Abercrombie	Orval Lee Lering (M)	Porterville, Route 4, Box 36
Vista	San Diego	26,340	—	26,340	Thomas Adams	Elsie H. Crenshaw	Leroy A. Wright	John W. Collins (M&E)	Vista, 202 W. Connecticut Street
Walnut	Los Angeles	—	—	—	Charles Grace	Catherine L. Corbin	———	George Johnston (M)	Downey, 9570 Gallatin Road
Waterford	Stanislaus	2,000	1,500	3,500	Isaac F. Bashor	Cecil C. Hensley	P. J. Minasian	William F. Lehmkuhl (M&E)	Waterford, 320 E Street
West Side, The	San Joaquin	7,100	1,625	8,725	Ernest J. Pombo	Wylsgy R. Hansen	Alfred A. Souza	W. F. Woolley (E)	Tracy, 1320 McKinley Avenue
West Stanislaus	Stanislaus	500	2,000	2,500	Walter Hector	Lawrence D. Harrison	Gant & Gant	W. F. Woolley (M)	Westley, Front Street
Woodbridge	San Joaquin	25,000	40,000	65,000	S. W. Beckman	Mable Hall	Jones, Lane & Weaver	K. S. Welsh (M)	Lodi, Route 2, Box 148

Water Storage Districts

Arvin-Edison[27]	Kern	—	—	—	Forrest Frick	C. B. Dickey	Baker, Palmer, Wall & Raymond	R. M. Edmonston (E)	Bakersfield, 359 Heberfelde Bldg.
Belridge[27]	Kern	—	—	—	George L. Henderson	Herschell W. Graves	Owen F. Goodman	G. L. Henderson (M)	Bakersfield, 2901 H Street
Buena Vista[27]	Kern	1,200	3,500	4,700	L. F. Freeborn	Gino Torigini	J. E. Woolley	Harold H. Russell (M&E)	Buttonwillow, 525 Main Street
North Kern[27]	Kern	—	—	—	Glenn E. Stanfield	Jane Mathews	Burnham Enersen	Glenn E. Stanfield (M)	Bakersfield, P. O. Box 380
Rosedale-Rio Bravo[27]	Kern	—	—	—	Paul Enns	A. L. Bussel	Baker, Palmer, Wall & Raymond	Boyle Engineers (E)	Bakersfield, 2714 L Street
Semitropic[27]	Kern	—	—	—	Sam Barling	J. K. Abercrombie	J. K. Abercrombie	———	Bakersfield, 2714 L Street
Tulare Lake Basin[27]	Kings, Tulare	—	—	—	Louis T. Robinson	Dan Hadsell	Dan Hadsell	Ralph Macdonald (E)	Hanford, P. O. Box 602
Westplains[27]	Fresno, Kings	—	—	—	Stephen Pilibos	Price Giffen	Wm. F. Decker	Stoddard, Karrer & Banks (E)	Fresno 21, 418 T. W. Patterson Bldg.
Wheeler Ridge-Maricopa[27]	Kern	—	—	—	Onie Sanders	Steven Wall	Baker, Palmer, Wall & Raymond	R. M. Edmonston (E)	Bakersfield, 2714 L Street

(M) Manager
(E) Engineer

[27] Since no report was received, it was assumed that the officials were the same as for 1962 report.

SOURCE: Bulletin 21-63, "Irrigation and Water Storage Districts in California: 1963", State of California, D. W. R., October, 1964.

APPENDIX D: Bibliography

All the reports and papers covered are too numerous to include here, hence, only the most important are given.

(A) Reports and Research Studies

(1) "Economic Considerations in the Formulation and Repayment of California Water Plan Projects", Stanford Research Institute, 1958.

(2) "Economic Factors in Kern County Water Agency Policies", Stanford Research Institute, Project Report by Neil T. Houston, September, 1964. Prepared for Fair Water Policy Coordinating Council, Bakersfield, California.

(3) Water Rights Transfers--An Engineering Approach--J. E. Flack, Ph.D-dissertation Stanford, 1965.

(4) "The Public District in Integrating Ground and Surface Water Management.

A Case Study in Santa Clara County", S. C. Smith, Giannini Foundation Research Report No. 252, April, 1962.

(5) "Water Pricing and Allocation with Particular Reference to California Irrigation Districts." M. F. Brewer Giannini Foundation Report No. 235, October, 1960.

(B) Tests.

(1) "Water Supply; Economics, technology and Policy", Hershleifer, Dehaven and Milliman, 1960.

(2) "Economics and Public Policy in Water Resource Development", Smith and Castle, 1964.

HD1695 S383G36 1965

"A Study of Water Pricing With Reference to Water Agency Practice In California."

A Report to the Santa Clara County
Flood Control and Water District

by

Colin A. Gannon

September, 1965

Preface

The formulation of a water rate schedule, like other economic problems, is a recurring one in time and in space, and as such, it suggests that some insights might be gained by reviewing the water pricing schedules and policies followed by other water agencies selling water under similar circumstances. Accordingly, the water pricing practices employed by several water districts, the California State Department of Water Resources, the U. S. Bureau of Reclamation, U. S. Corps of Engineers and the U. S. Department of Agriculture are investigated. The results of this present investigation are not presented as an exhaustive study or an original one. Only a superficial look at agency practice is achieved, however a theoretical framework is established and some current water agency pricing behavior is evaluated. Thus, this report is not an original study. It is at best forms, a collection of some recently expressed expert opinion supplemented by some typical data both pertaining to the question of water pricing. The writer in the brief time available to complete a study of such an involved and controversial field as water pricing believes that this approach was the most efficient one in terms of information, collection examination, condensation and presentation. Although this report is certainly not an exhaustive treatment and examination, the writer does feel that it serves its intended purpose - namely that of providing the district with a preliminary report on:

1. The economic theory underlying water pricing.
2. Some comments on the implications and policy behind recent water pricing practice in California.
3. Data on some current district water pricing schedules and policy.
4. A discussion of several aspects of these current pricing practices and suggestions for improvement.

ACKNOWLEDGEMENTS

This study has been an attempt to obtain information and data. Upon beginning this study, I found that one large and difficult aspect was, as if often the case, obtaining current, meaningful data. A further task, as I was not fully familiar with many of the finer economic and practical details of water agency pricing behavior, was to find relevent technical and expert economic opinion.

I am greatly indebted to a large number of people, who gave me greatly needed assistance during the short period of just over four weeks, that I spent on this investigation.

I owe many thanks to the economic section of the California State Department of Water Resources at Sacramento particularly to Messrs. Staum Lerner, Sata and Warren for their assistance. I also was kindly assisted by a number of people in providing me with reports and other sources of information, particularly Mr. G. Brown of University of California and Mr. N. Houston of S. R. I.

Several government departments have also aided me in obtaining financial reports, addresses, etc. of Water Agencies in California.

Thanks are also extended to the Monterey F.C. and W. C. D. for permission to attach a report by John Mamer. To the other persons who assisted me, I also wish to extend my thanks.

A special note of gratitude is due to Professor Margoles of Stanford University for his helpful suggestions and guidance and for the provision of many of the reports used.

Finally, I would like to thank Mr. Lloyd Fowler of Santa Clara County Flood Control and Water District for his help, assistance, and indulgence in this endeavour.

Colin A. Gannon

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SECTION 1: Introduction

To obtain objectivity in water resources allocation, price determination, and cost allocation, economic issues must be divorced from irrelevant issues. This is not to say that economic issues are, can, or should be the governing criteria for water development or more specifically, as far as this report is concerned, -- water pricing. A full examination and investigation into the forces which determine a water pricing policy and schedule of rates is far beyond the scope of this report. It is a task which would involve examination of the functioning of a public district, including an investigation of the legal, political, and physical characteristics as well as economic considerations.

A public district, especially where the organization must resolve the conflict interests between many classes of users, classified as municipal, industrial and agricultural (broadly), and must integrate management of ground and surface water among these water users requires an organizational structure that will permit decisions which compromise among the different viewpoints expressed by the district constituents.

In short, it is a herewith stated premise to this report that no attempt has been made in the short time available to propose a scheme of integration of the political and legal factors with economic considerations and come up with an equitable pricing policy and schedule.

Rather the writer of this report has approached the question of water pricing from two very fundamental and certainly basic faths.

Firstly, an outline will be given of ;the economic theory which underlies water pricing. The main purpose of this theoretical discussion is to expose some gross errors which can easily be made by public water agencies and to demonstrate how in many cases simple and practical remedial measure in terms of pricing practices may be applied. An outline of the theoretical framework of water pricing also serves another important function. It provides policy decision makers with the criteria and rules under which theoretical economic efficiency may be reached, hence, the decision maker is made fully aware of what cost is sacrificed in terms of lost efficiency when, because of "real world" political and legal constraints, a departure from pure theory is necessary. This information, is the cost of lost efficiency, thus allows more rational and knowledgable decision making process.

The second approach adopted by the writer was to attempt to gather data and information, on current water pricing schedules and policies from a selected number of representative water agencies in California.

The idea behind this approach being obvious one, ie., to examine current pricing practices of "similarly characterized" water agencies with a view to gain some common insight into current pricing methods, trends and perhaps underlying policy. Altogether, thirty-one water agencies were asked to provide information on their pricing schedules for all classes of water and for additional information on other revenue sources (such as ad valorem taxes and power sales) that affect the pricing schedule. In addition, information was also requested on the pricing policy of each agency, especially the reasons for a differential pricing of water for different classes of use if a differential existed. The results of these two approaches form the basis for the report which follows.

Water Pricing Policy and Water Problems

To facilitate a broader understanding of what is an efficient and a proper water pricing scheme and to provide a sound basis for objective discussion, it is necessary to expose the inherent relationship which exists between any such water supply situation and its accompanying water supply charges. It is commonplace today to hear that the supply of water for households, agriculture and industry in the United States is a growing and an alarming problem. It is certainly true today that the gross rate of use of water for irrigation, industrial, and public supplies is steadily arising while precipitation is not Thus it might appear at least in the long view that there is cause for real concern The question therefore arises, as to how we are going to meet an increasing demand for water Hirshleifer and many other writers in the field of water supply economics have offered three main solutions. They are:

1. Where economical, engage in multiple reuse of supplies where every drop of water is made to serve a multiplicity of purposes in the available ground phase of the cycle.

2. Argumentation of supply from new sources (aquifers, depalinization and reduced evaporations loss etc.,) and,

3. Efficient allocation of water resources where price is determined by the pressure of demand of all the various uses weighted equally. The highest price which equates supply and demand is one charged. Practical limits to charges in scale of operation are recognized and practical difficulties in measuring demand and supply curves are also realized. However, it is first necessary to establish a theoretical framework based on the economic theory of resources, pricing and allocation so that various water pricing schemes may be evaluated and a guide line established for future water pricing proposals and policies. It is with this last proposed solution to water problems, namely efficient allocation based on equating supply and demand theoretically at the highest price that we shall be concerned in this report.

If during any period the total available water for use is considered to be an absolute limit then the efficiency of utilization of water supplies can always be increased as demand rises since more highly valued uses could bid away some of the water from less highly valued uses. Under such circumstances as pressure of demand upon water supplies increased those uses which could not bear the burden of higher cost would be forced to give up their supplies (irrespective of their type of use) to those more intensively demanded uses which can. Thus for water, as for other limited resources, we may state as the basic principle of supply that there is always more available to any user whose demand is sufficiently highly valued to permit him to bid an existing supply away from a current user.

Furthermore, for a reusable resource like water there is more available to society as a whole whenever people become willing to pay the cost of reclamation. The principle outlined above has introduced an important and different concept, namely, an economic water shortage as distinct from an absolute shortage in the sense of a fall in supply as compared with past historical periods where there is a real permanent decrease in supply (e.g. overdraft on an underground aquifer). The economic water shortage has a simple cause and cure from the economic point of view i.e., raise the price. However, there may be serious political difficulties in implementing such a move. With absolute shortage the community must adjust to higher water costs or to reduced utilization unless technological advance lowers cost or source of subsidy or augmentation can be found.

Supplies and demands for water are not absolutely determined by natural forces and engineering requirements but rather are to be measured in terms of the economic balance of all the needs and resources of the community. Where water is cheap and other resources are scarce, water can be liberally applied to industrial, domestic and agricultural uses then even recycling can be minimal as consumptive uses may not be severely penalized. Where water is scarce and expensive (in terms of other resources that must be sacrificed to make more water available) it becomes justifiable to construct elaborate supply facilities and minimize intake recirculate quantities withdrawn, and to avoid uses that are consumptive.

A discussion will now be given on the principles that should govern the allocation of existing supplies between competing uses and competing users. A satisfactory pattern of water utilization with the adoption of practical corrections to price systems, for example, may enable the postponement into the indefinite future of huge engineering projects for developing additional supplies. There is competition for the use of water and generally speaking the more taken of existing supplies for any one use or user the less there will remain for the others. Since 'needs' for water are indefinitely expandable, there will always be competition for the use of the existing supplies. Instead of the ugly picture of competing efforts in the market, allocation of water is usually determined politically. Problems will arise out of market place competition for water supplies and of course there are problems arising out of political or bureaucratic allocations of water. However, the latter procedures cannot eliminate competition for water, the conflict of interest remains whatever the process for making the decision. The only effect is that competition is shifted from the market arena to the political arena as each contestant attempts to influence the outcome through control of votes and political influence instead of dollars and economic influence. The economic effects of any proposed policy can be divided under two headings - the effects on efficiency and the effects on distribution. Efficiency questions relate to the "size of the fee available," distribution questions as to "who gets what share".

Economics can say something of the distributional consequences of alternative possible policies that stop short of any assertion that any man's interests or well being can be preferred to anothers. Most of what the existing body of economic thought has to say concerns the efficiency effects, the effect on size of the supply of alternative possible policies or institutional arrangements. Economics alone cannot give us answers to policy problems. It can show us how to attain efficiency but it does not tell us how to distribute the gain from increased efficiency. Often, efficiency and distributional consequences of a proposed change cannot be so neatly separated, yet nothing is so common in discussions of economic affairs than a consideration of distributive effects of any change to the utter exclusion of the efficiency question (i.e. the agricultural price support policy).

The Principle of Equimarginal Value in Use

Usually for simplicity it is assumed that water becomes available without cost. The only problem being to allocate the supply among the competing uses and users who desire it . The value in use of any unit of water is essentially measured by the Maximum amount of resources (dollars) which the consumer will be willing to pay for that unit. Marginal value in use is the value in use of the last unit consumed, and for any consumer marginal value in use will ordinarily decline as the quantity of water consumed in any period increases. The principle then, is that the resource should be allocated so that all consumers or users derive equal value in use from the marginal unit consumed or used. One possible institutional device for allocating water supplies of a community would be to establish say a municipal water supply enterprise which would sell water, the consumers being free to take any amount desired at the price set. The price should be equal for all and at such a level that the consumers or customers in the aggregate use up all the supply. Since the customer is permitted to purchase any desired amount he will continue to buy additional units so long as the marginal value in use to him exceeds the price he must pay, marginal value in use being defined in terms of the price he is willing to pay for an additional unit. Evidentally he will stop purchasing where marginal value in use equals the price-and so, if the price is equal to all customers marginal value in use will be equal to all. Then no mutually advantageous trading will be possible. So that we have achieved an efficient allocation of the water resource.

The Principle of Marginal Cost Pricing.

We may state that on, efficiency grounds, additional units should be made available so long as any members of the community are willing to pay the additional or marginal costs incurred in providing them. To make the criterion equimarginal value in use, however, the price should be made equal to all customers to the combined rule is to make the price equal to the marginal cost and equal for all customers.

One important practical consideration is that because of differing locations, use patents, types of service, etc., the marginal costs of serving different customers will vary. The correct solution is to arrange matters so that for each class of customers (where the classes are so grouped that all customers within any single class can be served under identical cost conditions) the prices should be the same and equal to marginal costs. Between two (or more) classes, however, prices should differ, and the difference should be precisely the difference in marginal costs involved in serving the two.

In short, where water is sold to customers, therefore the principles indicate that customers served under identical cost conditions should be supplied and priced in such a way that the price for each class of service should be equal to the marginal cost of serving that class. Where marginal costs differ, prices should differ similarly.

Allocation with Complimentary Uses.

In considering the sale of water to say a pair of industrial combinations the principle is to equate marginal costs to the sum of the marginal values in use of the two allied users.

Existing Pricing Practices in Water Supply.

Our analysis of the principles of efficient allocation among competitive users led to the conclusion that prices should be equal for all customers served under equivalant cost conditions and that the price should be set at the marginal cost or the cost of delivering the last unit. Alternatively, we may say that the amount supplied should be such that the marginal cost equals the amount the customer is willing to pay for the marginal unit.

Examination of the allocation arrangements of local systems for domestic, commercial, and industrial water supply (primarily municipally owner) reveal that the great majority allocate water by charging a price for its use. The leading exceptions are in unmetered municipalities where since water bills are not a function of consumption, water deliveries may be considered free to the consumer. While a certain amount is ordinarily charged as a water bill in such cities this is a fixed sum (or flat rate) and does not operate as a cost does in leading consumers to balance the value of use against the cost of use. It may be said that in the United States a condition of Universal metering has been approached. As of 1954, metering covered from 90 to 95% of all services. (Reference: Modern Water Rates, published by the American City Magazine (New York, 1955) pp 1-2.)

An unmetered consumer will proceed to use water until its marginal value in use to him is nil to correspond to its zero price to him. This is, of course, wasteful because a water system cannot provide the commodity costlessly and hence society will lose (saving distributional considerations aside).

A situation in which different prices are charged to different users or to the same user for varying quantities of the same commodity is called on of the 'price discrimination'. While discrimination may under certain conditions (e.g. to recover total costs of a utility enterprise) be justified it has the defect of preventing the marginal values in use from being made equal between the favored and the penalized user or users. The only exception to the statement is where discrimination is applied within the purchasers of a single

Unfortunately, there do not seem to be any nationally compiled data on the methods used by irrigation enterprises to charge for water supplied. A tabulation by the Irrigation District's Association of California indicated considerable variation in practice:* some districts made no charge except by assessment of property; others charge a flat rate, either

(1) A fixed amount per acre, or

(2) Depending upon the crop, a variable amount per acre still others have mixtures of pricing methods and other charge per unit of water either flat rate or declining block.

Where no charge or only a flat rate charge is made for water the marginal price for water to the user would be zero if in fact the user can take unlimited quantities as a domestic consumer normally can (subject only to the limited size of his connection). Further, it seems to be fairly common practice in irrigation districts that the water is more or less rationed to the user; any price serves as a fiscal measure to cover the operating and maintenance costs of districts and not a market price in the ordinary sense.

*See Appendix A

(4) The important Palo Verde irrigation district on the Colorado River in California, which has no acre foot charge for water, rations use by the device of denying the farmer the privilege of pumping excess water into district drains. His use of water is, therefore, limited by the natural drainage of the soil.

Potentialities of Major Water Reallocations

It appears that even less attention has been devoted to the optional allocation of water between systems serving municipal or agricultural consumers than has been given to allocation of supply among the customers of a given system. It is true that transfers of use within a given distribution network will almost always cheaper than that between such systems. It seems that by and large water planners will go to considerable lengths to develop presently unutilized supplies rather than to consider shifts of use between already developed sources.

So far as pure theory goes, there is no special difficulty that transfers between systems as opposed to within systems (the ideal system so far as efficiency is concerned is to make the marginal values in use everywhere equal) or, when we take transfer costs into consideration, transfers should take place so long as the disparity in marginal values in use exceed the transfer costs. If perfect markets for water existed, this result would be brought about automatically since the higher valued users could buy out the lower valued users at some mutually advantageous price.

The Major Consideration in Treating efficient allocation of water resources in undoubtedly the imperfection of property rights in water-most conpicuously the limited transferability of water rights.

Prima faire evidence that room for improvement exists is provided when the cost incurred by distribution systems in prowring water differ by more than can reasonable be ascribed to the cost of importing water between the areas in comparison. Our permanent disparites are only a suggested indication, however. Pricing of water, in particular is irrational to such a wide spread degree that mere differences of price cannot automatically be taken to indicate differences of marginal value in use. In some systems, for example, water may have the price of zero and yet be rationed among users, so that the marginal value in use will, for at least some users, (those who desire to take more than their assigned ration), be greater than zero. We cannot then assume that a mutually satisfactory exchange can be made between such a system and a system charging its customers a positive price for water.

Two objections -- one is fallacious, but the second is not - - are commonly made to the exchange of water supply systems. To take erroneous argument first; it is frequently stated that the price paid for water is not indication of its true value in use (even assuming no rationing) because the water makes the production of additional wealth possible. Thus an Imperial Valley farmer may pay his irrigation district eight dollars (two dollars per acre foot for four acre feet of water) but the value per acre of crops produced might be in the neighborhood of $175.

This objection is fallacious in two respects. The less important error is failing to take into account the other factors of production. Thus the production of crops valued at $175 in the Imperial Valley requires not only an import of water but of labor, machinery, services, etc. If the water were taken away, these other imports could be made available to assist in production elsewhere. Even allowing for this factor, the net productivity of water per acre might, on the average, still be considerable above eight dollars -- let us say it would be $50 after subtracting the cost of other cooperating imports. The second and more important point is that this $50 is the average productivity of water and npt the marginal productivity--ie. the productivity of the last unit. If the water is not rationed we can then assume that this process has been carried to its limit so that the price per unit of water measures its marginal productivity however great the average productivity may be.

Now it is true that, if it were proposed to deprive an area entirely of water it would be the average productivity of water which would be lost and which should, therefore be taken into account in the comparison.

What would be more reasonable, however, would be a purchase of a fraction of the water supply--let us say 1/8, so with a loss of water available for application for crops the farmer will modify his cropping practices.

Increasing urban demands can probably be more economically served by the purchase of fractional shares of supplies in a number of agricultural areas than by the purchase in their entirity of water allocations in just a few locations.

The fact that water has a higher marginal value in use elsewhere means that other customers value more highly what the increment of water in question can produce in industrial uses (or what is worth to them in direct consumption for household purposes) than they value the additional food produced. If, nevertheless, the demand for food grows irrigation will be able to outbid the other users and recapture the water when the need arises. In neither case is any particular intervention in favor of irrigation necessary or desirable. Irrigation preference proponents will often cite not only 'needs' for water but the value of crops produced, the provision in employment in crop using industries or in communities serving farmers, the taxes paid by farmers, and the incidental benefits of irrigation projects in the way of power, naviagtion, and flood control. All these considerations, whatever their true weight might be, are fallacious as justification for special preference to irrigation. A corresponding list could be made up for the use of water in any sector. The assertion that the value in use for the increment in water in question is the relevant criterion.

The second and more correct objection to transfering water rights between areas is based on the fact that such a transfer may adversely affect third parties. The effects of transactions upon third parties is one aspect of what is known as 'spillover' problem Although the spillover problem is not entirely separable from water pricing policy considerations (e.g. spillovers pecuniary) because of time limitations we will not deal further with this aspect in this preliminary discussion.
(Note: In this discussion the principles of the economic theory of choice -- the principle of equimarginal value-in-use and the rule of marginal cost pricing have been outlined on the basis of common-sense considerations for application to the problem of best utilization of existing water supply. Applying these principles, it was pointed out that deficiencies in existing practices relating to tenure of property rights in water, and to pricing of water by public enterprises and to exchanges of supplies between major water systems do exist.

For any given quantity the marginal value in use was shown to be essentially equal to the price at which the consumer would voluntarily purchase the quantity in question or i.e. the schedule of marginal value in use is essentially equal to the 'demand curve' of economic theory, which relates quantities demanded to price.

Unfortunately, the problem of inter-personal comparisons-- the choice between A's Satisfactions over B's cannot be entirely avoided. Our argument indicates that, if A's marginal values in use is $10 when B's is $4 another unit of supply should go to A. But how can we justify preferring A's $10 to B's $4? The explanation is that we could in principle force A to discourage $4 of his $10 to B leaving the latter no worse off than if he received the unit of commodity, while A is still the equivalant of $6 to the good. It is true that such compensation is not always paid. Sometimes there are practical difficulties preventing it.

Whether an enterprise is private and unregulated, private and regulated, or public, the condition that marginal cost should be set equal to cost is the desireful solution from the point of view of economic efficiency consideration if the total conditions for an optimum are also met. Where free competition in the economic sense exists, market processes tend automatically to bring about the optimum.

Note 2: The common pool problem occurs when a number of overlying property owners are engaged in competitive pumping of water from a common underlying aquifer. Three solutions--that is, methods for assuring that the decisions made will meet the criteria of allocative efficiency have been proposed for common pool problems. They are:

1. Centralized decision making,

2. Assignment of pro rata production rights or quotas and,

3. Imposition of 'taxes'.

Theithird or 'use' tax solution to the common pool problem is in some ways logically the neatest an is related to water pricing. Each pumper, in deciding to withdraw, compares the marginal cost of pumping with the marginal value in use to him of the water. This will usually be the value of the marginal product. However, his withdrawals will tend to lower the water levels for everyone using the common pool--a consideration which he will ignore or at least not fully consider. The use tax solution would require a payment that would be added to the cost of pumping so that ideally, the individual would consider the marginal social cost in his decision of how much to pump rather than merely the marginal private cost. The payment, of course, would represent the loss of productivity on lands owned by others.

The optimum tax would vary with changing price. The difficulty is in achieving rationality all the time. The latter reveals itself in the use tax solution in the problem of how to determine the marginal social cost, since the increased cost of pumping in the future imposed on others is the major element in the diversions between social cost and private cost.

Among the various possibilities, the solution to the common pool problem that is found most attractive is the principal of establishing quota rights. The strongest arguments in favor are the simplicity and the comprehensibility of the solution and the fact that the quotas come closest to remedying the local essence of the common pool difficulty--the nonspecificity of property rights.

Defects in Market Allocations--Political Allocation

A brief mention is now made of some more or less philosophical questions related to defects in market solutions and calls for or justifies government intervention to correct them and the political decision process is a method of permorming the economic function allocating a commodity like water.

It is clear that socieyt, or rather the individuals comprising society, value other things besides commodities, (goods and services). 'Liberty, equality, fraternity' comprise one such set of valued ideals not reducible in any way to economic measures.

Also it seems plausible to assert that there are higher and lower tastes and economic values fail to indicate this distinction.

The law and analygous, social pressures tend to correct market forces on the matter of 'higher, lower' tastes. If government intervention is consistently viewed as expressing deliberate social pressures there is relatively little we can say of existing policies and procedures. We could not then object to the subsidies given to irrigation, since what is presumable involved is a correction of the market process which must be failing to take into account certain extra market values attached to irrigation. We cannot here regard the political process as automatically insuring socially optimum results. On the other hand, we cannot regard the political process as automatically insuring socially optimum results. On the other hand, we cannot regard the political process as utterly devoid of rationality either. The implication is that the political process is one which can respond to rational analysis. Certain policies are mistaken, that is, that they incorrectly represent what we believe the correct social preferences are. The subsidy to irrigation, for example, will be regarded in this light, because it ultimately can be justified only on the basis of particular interest. We should try as consistantly as possible to separate judgements of social preferences from analysis.

Ordinarily, we think of political processes in a democracy being fundamentally representative in nature-decisions are 'made by the people through their agents'. However, individuals acting in the capacity of representatives cannot in the nature of the case be expected to be merely disinterested agents of the voters.

In the beginning of Section 2, water rights were examined in a very limited context. The question emphasized was whether existing systems of rights equate marginal values in use for all consumers served under identical cost conditions. Equalization of marginal values in use can be achieved most simply by nondiscriminatory sale of water (charging a common price to all, except for taking into account any differences in serving the various categories of demand). A previous examination also indicated that marginal cost pricing was the appropriate principle for determining the general level of rights as well as the procedure indicated by economic theory for differentiation of rights where costs differences of service do exist. We will now look into municipal water pricing in more detail evaluating existing and recommended practices of the industry in the light of the principles developed earlier.

Municipal Water Pricing

The optimum allocation of municipal water supplies is of considerable economic importance. Actually, municipal water systems provide only about 7% of current gross supplies, defined in terms of withdrawal. But municipal water is generally the most highly valuable from the cost and the demands points of view. Crowded areas present the most intense demand for water, and in serving this demand relatively heavy costs are incurred in transporting, purifying and distributing water supplies possible gathered at great distances from points of consumption.

While it is an overstatement to hold, as many do, that water resources are in some special or unique sense the basis for civilization, it is probably the case that almost nowhere else in the total value in exchange of the resource so low relative to the aggregate in use. This argument does not imply that the low market water price for water is in some sense incorrect but rather that the importance of water allocation decisions may be far greater than is suggested by this relatively small market involved.

A committee of the American Water Works association has compiled a report on water rates which was reprinted as the water rates manual. (Amercian Water Works Association, Water Rates Manual, New York, 1957).

This report represents the current best thinking of the industry on the matter of water rights and, in fact, although the report may be criticized from the standpoint of economic analysis it is on a whole a useful document.

The central idea or principle underlying the report is that prices should be set so as to cover the cost distributed to each class of user. In the words of the report: 'an attempt is made to present definite rules for the formulation of rates which will distribute normal expense among all customers, as nearly as possible in proportion to the cost of supplying the commodity.' From the theoretical point of view this principle is defective on several counts. First, it certainly implies prices based on average cost rather than on marginal cost. Second, where several classes of customers exist, certain joint expenses will typically be incurred on behalf of all which cannot be properly assigned to any class separately, but the principle embodied in the report evidentally would require division of such costs among the separate customer classes. Third, the report assigns historical or 'sunk costs' which are not relevant for current decisions.

Average cost pricing is inefficient; it is marginal cost pricing which leads to the best use of resources. No special problem arises where the marginal cost price is higher than average cost at the output determined by that price. Where the marginal cost price is lower than the average cost price, however, a loss will be incurred at the optimul price. Various solutions are available in theory for coping with the problem thus created without sacrificing economic efficiency, but each of these phases more or less serious objections in practice. Nevertheless the goal of marginal cost pricing even in this difficult case can be approximately achieved by five possible methods which will now be outlined in brief.

1. The most obvious way of covering the loss is through a government contribution (subsidy). A somewhat analogous distribution takes place, in effect, when costs are allocated to nonreimbursable (e.g. flood control) in a multipurpose water project. Government contributions are in fact by no means uncommon in public water supply enterprises. The Metropolitan Water District of Southern California has typically run an enormous loss on water sales, the balance being levied as a property tax on the member communities. The typical low owerall level of water rates in publically owned systems, can in fact only be maintained with a government contribution--direct or hidden.

2. Attempts to capture as revenue part of what would otherwise be 'consumer surplus'. A theoretical possiblility is to operate at the optimul output but to announce that the enterprise will be abandoned unless sufficient voluntary contributions from consumers are received to cover the total cost incurred.

3. Another solution would have the utility discriminate by

setting up a descending scale of prices as a function of quantity taken, but subject to the guiding rule that each customer must end up paying the same marginal price (i.e. price for the last unit consumed) and that this marginal price equal marginal cost. The practical difficulty, of course, consists in the probably unacceptability of the trial and error process.

4. A fourth possible solution is the two part tariff: each customer could be charged a single price per nnit of output purchased that in addition, he could be required to pay a lump sum amount for the privilege of being permitted to buy at all. This solution does have an imperfection in terms of efficiency. Some customers that might otherwise have taken out or just a few units of product may now decide to dispense with it entirely, even though they are willing to pay for the output more than the marginal cost of producing it.

5. Ordinary price discrimination not satisfying our conditions in 3, above. Such discrimination consists in classifying customers so as to separate the market into two or more sectors, with prices varying from submarket to submarket. This is neither marginal cost nor average cost pricing, but it is a way of coping with the problem of deficits at a single price.

Reference is indicated for method 3 discrimination with equal marginal prices for all. Method 4, a two part tariff, involving a common price for units purchased plus possible differentiated lump sum charges is as second choice.

The Problem of Joint Costs

Where as in the problem of water utilities, different classes of service exist for which some cost are separable while some are common or joint the average cost concept runs into additional difficulty. The relevant classes of service involving cost differentials might be defined by geographic locations, by quantity demanded, by time patent of demand, and, on occasion, by other features (distinctions between gravity and pumped service, firm and intermittant service, and qualities of water delivered are among the possibilities here). In each of these cases some costs will be clearly separable in the sense that they are incurred solely for the benefit of a single user or a singly defined class of users. Such costs may be fixed or variable as a function of output. Other costs might represent investment or current outlays on behalf of facilities that serve several users or several classes of users in common.

The total of the joint or common costs would have to be 'allocated' among those classes of use and then added to the respective separable costs. This leads to a difficulty often expressed by some phrase like 'the allocation of joint costs is arbitary'. This may be somewhat misleading because, for any economic decision there is a unique incremental cost 'allocation' which is the relevant one.

In any problem the question to ask is: what costs are incremental to this possible cost or decision as compared with the alternatives?

The crucial point, however, is that these allocations of total cost are of relevance only for certain investment decision problems and not for the pricing problem. For pricing decisions all that is relevant from an economic viewpoint is the marginal cost, and in principle there will be no difficulty in finding the increase in the total of the common costs due to a unit increase in output of one product or for one category of use. To this increment and common cost must be added, of course, the increment in the appropriate separable cost for the product or use involved, the sum being the correct marginal cost.

Costs as a function of scale of output and the associated long run and short run marginal problems will not be discussed except that for a demand pattern guaranteed by a long term contract, the price can essentially be set at the relatively stable long run marginal cost of service rather than at the fluctuating short run marginal cost.

Classification of Costs: customer capacity and commodity

It has become common to classify the cost of utility in the (capacity or demand) customer, and commodity costs. These are usually defined as the costs that are proportional respectively to the size of plan, the number of separate services, and the volume of the commodity delivered. ('Hopkinson"

Classification).

While total costs cannot be divided among the dimensions, the marginal costs for each is determinable: the cost of adding another customer, with capacity and deliveries constant, the cost of adding a unit of capacity with customers and deliveries constant, and the cost of increasing delivery by one unit with customers and capacity constant. These costs are measurable and relevant for pricing.

As has already been mentioned, the Water Rights Committee of the American Water Works Association following conventional practice in public utility pricing, attempted to establish correct rights on the principle of recovering assigned to different classes of users. Their analysis led to the recommendation in favor of what already is common practice in the industry, a multiple part tariff consisting of a fixed charge plus a schedule of declining block prices for actual deliveries.

Following the Hopkinson Classification, appropriate parts of the annual costs, including both fixed and operating costs, were assigned by the committee to special uses (see below), to customers, and to meters and to services. The remaining fixed costs were intitally assigned to the capapcity 'component' and the remaining or running costs to the 'commodity' component of cost. However, the nature of water enterprise technology is such that the fixed costs are relatively large (from 1/2 to, perhaps, 2/3 of all costs), requiring under this allocation of cost principle a very high capacity or demand charge independent of the actual quantity of the commodity consumed. The Committee was sufficiently disturbed by this as to be led to quote, with approval, a suggestion that 'theory should not be carried to extremes' and that consumption (commodity) charges should, in all cases, carry the major part of the entire service'. An allocation of 50% of capital cost to capacity and 50% to the commidity was recommended, this division was justified in the report by the observation that the average day water delivery is commonly about half that of the maximum day. It seemed to Hirshleifer that the custom of the industry has dictated a certain proportion of a fixed service charge and the amount paid for water as a function of delivery, and the committee was forced to bend a defective theory to accord with this usage.

Commodity and Capacity charges

With respect to customers, the additional expense as incurred in connecting another customer to the system is the marginal cost we should be assessed as a once and for all payment, to the customer. Other customer costs are of a continuing nature (e.g. cost of reading meters), and all customers should periodically pay the current marginal cost of this service.

The area of most serious practical importance in the committee report relates to the commodity charges. The committee recommends the principle of declining block rates. These are used to recover the total costs remaining after assignment of appropriate parts of the annual cost (including both capital costs and operation and maintenance costs) to special uses, to customers, and to meters and services and allocation of 50% of the remaining capital costs to the fixed service (demand charge). The remaining costs are devided into two categories: production and distribution (there are both fixed capital costs and operation and maintenance costs in these catagories). The production costs alone have been divided by the annual output to get the wholesale rate while the distribution costs are allocated primarily to domestic users and secondly to intermediate users. Note the implicit and 'untrue' assumption that the output is independent of the rate charged. The typical rate structure derived in this way is 4.3 cents per 1,000 gallons for wholesale consumers and 5.8 for intermediate and 8.2 for domestic.

This analysis would, if it could be assumed that the figures above showed the marginal costs to the various classes of users, justify the different rates arrived at for the different classes of users. For some unexplained reason, however, a single rate schedule is then applied in the report to all customers on a block basis: the first 750,000 gallons even to wholesale users are charged at the domestic rate, the next 675,000 at the intermediate and all other 750,000 gallons at the wholesale rate. Note this three step division is conservative.

The rates derived above can be justified only if they show the marginal costs to the various classes of users. On the principle that has been outlined a single rate corresponding to the marginal costs should be applied to each class. Obviously, if a wholesale user gets a lower rate because no distribution system expenses are incurred on the margin for each service, he should not have to pay even for his first

75,000 gallons a domestic rate based on the existance of such expenses. Conversely, an intermediate user who must be served through a distribution system should not get the benefit of the wholesale rate just because he happens to consume an unusually large quantity.

The conclusion is inescapable that the standard rate systems now recommended by the American Water Works Association are not only defective in theory but inconsistent in application.

Capacity Charges and Peak Load Pricing

The question of capacity charges raises some subtle questions. One might be tempted to contend on the basis of the theoretical discussion earlier that there is no need to charge for capacity or ability to serve as opposed to actual deliveries. More capacity is built when rising demand for the commodity drives the marginal cost price sufficiently higher as to make an increased supply economically desirable.

This view is theoretically correct in the case of water or utility service, generally. The capacity charges would not be required in an ideally operating price system, however, there is a sensible argument for a two part tariff with a fixed capacity charge. This justification is based on the marginal cost of increased system capacity to make random flunctuations of demand.

One of the conditions of utility service is that the company stands ready to deliver at any time. To meet this requirement with a given level of statistical confidence, the company must provide some excess capacity over the actual average demand it can anticipate (in the nature of an option on the water company). From the company's point of view the long run cost of these options is the reserve capacity it holds in readiness to serve.

Different classes of users may consistently place differing maximum actual demands on the system. This is the so called diversity factor is measured by the ratio of the sum of the highest individual experienced demands to the group highest experienced demand. The fraction of reserve capacity against certain potential demands than against others, adjusting the demand charges accordingly.

Another predictable element in the maximum demand is the systematic patent of daily and seasonal variation. The principle for determining the demand charge remains the same: for each customer or class of customer the marginal cost of the fraction of capacity unit that the company holds in readiness for his demand is to be charged.

In public utility pricing this principle corresponds generally to what is known as the peak responsibility method of capacity cost allocation, except that it is the marginal cost of capacity which is relevent rather than the convential allocated cost.

With regard to a structure of the demand charge in water supply these frequently lie heavily on domestic users, i.e. the system must hold in readiness more capacity for a residential area than for an industrial area with the same aggregate consumption.

A third and most important non-random element influencing water demand is price. The elasticity of demand for water is around -0.4 (a 1% increase in water price will bring about a 0.4% decrease in quantity taken). This consideration permits an alternative approach to the problem of on peak and off peak demands. The capacity charge method regards the consumer as purchasing an option being related to the peak load imposed on the system. The other approach called peak load pricing is to regard on peak and off peak service as really two different commodities. This necessitates, of course, a commodity price varying by time of day and season.

Actually, a capacity charge based on the peak responsibility method differs conceptually only a little from peak load pricing. The peak responsibility method does have two difficulties, however. First it is generally incorrect to load all the weight of the marginal cost of capacity upon the peak; some of the marginal cost of capacity is ascribable to the demands of the non-peak periods. More fundamentally, basing the capacity charge on the marginal capacity cost is logically equivalent to long run marginal cost pricing, when it is short cost pricing which is relevent. With a given capacity in existance, the long run marginal cost is a constant; it is the short run marginal cost of service which varies on peak and off peak. In water supply, the major cost of an increment in peak service is probably the reduction in quality of service imposed on others through loss of pressure. In either of the circumstances a higher on peak price if required to deter on peak use to the point where marginal cost equals the marginal value of the service.

Another way to meet the problem of peak loads is to charge for special uses such as lawn sprinkling and air conditioning. One defect of this approach is that all special users are assessed the special charge, whether in fact they contribute to the peak or not. In other words, consumers are not required to meet a price actually detering them from on peak consumption.

With the exception of fire protection there would be no need to distinguish among users at all if higher rates could be used for the more scarce and expensive on peak commodity than for the plentiful and cheap off peak commodity.

Practical considerations in water supply peaking problems, reveal that brief peaks like those used in lawn sprinkling can ordinarily be handled by local storage, although, a degradation in quality of service (loss of pressure) usually occurs as well. The seasonal summer long peak will ordinarily require either very large reservoir storage or an inclement to storage capacity.

For water supply the ideal solution, involving a sophisticated system of peak load pricing, is impractical because of the high cost of special metering. A seasonal premium price for water (in the summer, ordinarilly) would not require any special metering, however. In the absence of peak load pricing, or to supplement a limited introduction of it, Hirshleifer favors capacity or demand charges based on the contributions that the different classes of service concerned make to the system peak.

Certain special uses, and in particular the need to provide a large excess of capacity for the purpose of fire protection service is one area where demand or capacity charge can be justified with little or no qualification. A National board of Fire Underwriters Committee reports favors a charge on the basis of the incremental capacity required by these standards over the capacity or normal uses (or, alternatively, the charge is to be based

on extra storage in lieu of capacity), plus the clearly separable cost ascribable to fire protection. (Perhaps what was assumed here is that the sufficient excess capacity is already available in the reservoir, certainly, in building a reservoir there would be extra costs in scaling it up to meet fire protection rate requirements). This is the correct cost, if interpreted as the current cost of providing and maintaining the capacity of operation, rather than the sunk historical cost.

In discussing the incidents of the fire charges, the AWA report correctly suggests that these should be related to the applicable insurance rates of the different properties. The report does not criticize strongly enough the pernicious practice of collecting the fire charges by increasing either the commodity rates or the demand charges. Actually the public fire charges should most sensibly be collected from the fire budget of the municipality.

The question of under pricing is most fundamentally reviewed as connected with phenomenon of over building of water supplies. A brief mention will now be made on this phenomonon. The AWA study indicated a gross return on capital, including depreciation, of only $4.90 per capita for public enterprises and $3.94 per capita for private enterprises. This figure is astonishingly low (roughly a 2% or 2.5% capital return gross of depreciation. The essential explanation for this phenomenon appears to be that despite our recent price inflation, public rates are based on the idea of recovery of cost expanded, which amounts to valuing the capital at historical or original costs, but on the average, represent a compromise between original and replacement values probably weighted more heavily toward the former. Private water utilities have found it extremely difficult to deliver the capital required for expansion. The answer seems clear that water rates are too low to cover replacement costs, because of failure to allow for price inflation in general as well as for what seems to be a relative price increase in construction costs as compared with price averages. As between publicaly and privately owner systems the former have the advantage of being able to finance exclusively by debt, whereas a private system cannot ordinarily secure capital except by a balance of debt and equity. Not only is the interest charged on debt characteristically lower than the earnings required to make equity acceptable to investors, especially as local governments can issue debt whose interest is exempt from federal income tax, but even more importantly returns to equity are taxed at the heavy 52% corporate income tax rate. Furthermore, the publicaly owned systems generally escape property and other minor taxes.

Therefore, water rates especially, those of publicly owned systems are characteristically too low to recover a carefully calculated cost. If the argument above is sound that marginal cost for the expanding water supply industry probably exceeds average costs, by and large, we may conclude a fortioni that current rates are far too low, primarily as a result of rate calculations based on the recovery of total historical costs without allowance for inflation or for the special low interest advantages which apply to the publicly owned enterprises.

One other point of great importance is the crucial role of the peak load demands discussed earlier in the underpricing old overbuilding picture. New water facilities are constructed to serve a peak demand only, thus being condemned to idleness of peak. It will usually be highly desirable policy to attempt to cut into the peak by a premium price (or a peak responsibility capacity charge) thus postponing new construction until (ideally) an increment to supply is justified by the level of the average demand rather than that required for localized peaks.

Secondly, the significance of the declining block or proportion promotional rate structure are possible inefficient as already mentioned and discriminating in favor or large users (the marginal value in use of large users may be less than that of small users).

Conclusion with regard to Municipal Pricing

In conclusion, it will be stated again that the marginal cost principle should be applied. The on peak demand should generally be paying a higher price than the off peak demand. The procedure in municipal water rates of attempting to recover the cost of extra capacity by a fixed demand charge on users is an inferior expedient, from the point of view of charging differential prices. This expedient, will however be justified if the extra cost of pricing and of special metering exceeds the saving in more rational utilization of water supplies. Fire protection is a use clearly falling into this catagory, and more generally it will be impractical to vary prices by the oour or vven by the day. Thus the cost of special metering is such that very elaborate schemes of differential peak and slack prices are not justified. The introduction of a peak season price (in the summer normally) seems clearly indicated as an alternative to expansive new construction when it is only the peak season load that press on the capacity. Thus as a practical matter, it is probably most urgent to introduce seasonal peak load pricing as this will not involve special metering problems. There are great possibilities offered by peak load pricing as an alternative to expensive new construction. In addition, the prices people are willing to pay on peak provide a way of valuing the additional water that will be supplied by such new construction.

In the past water has been so cheap that no very great rationality in its use has been called for. For the future, however, it appears that water supply will increase in cost relative to goods in general. Accordingly, we may expect a higher degree of rationality to be required in the future. Communities are faced with a choice between an expensive increment in supply or a more rational use of present supplies. The water industry is not yet so aware of similar possibilities available in pricing according to marginal cost, in charging higher on peak prices in place of a flat demand charge and in eliminating discriminatory favoritism which provides some classes of users with water at a lower marginal price than others.

SECTION 2 - PART B: Economics of Public Water Pricing Practice in California

As stated at the beginning of this report, an "all embracing" discussion of water pricing is well beyond the possible scope and intention of this rather brief report. However, it is important and instructive for some of the pricing methods that are available and/or presently being used by water agencies to be outlined in general terms, before the more specific data,obtained on current rate schedules of some selected agencies is presented. In this way an improved understanding of the specific examples to be cited will be possible.

The following discussion as it relates to a discussion of the various pricing methods used by water agencies in California is based largely on and consists of direct extracts from "Economics of Public Water Pricing: The California Case" by Michael F. Brewer, Giannini Foundation Research Report No. 244, May, 1961.

INTRODUCTION

A brief sketch has been given in Part A of the economic theory underlying the relation between water pricing and efficient allocation and utilization of water. Brewer discusses the efficiency of water pricing in practice.

"The empirical counterpart is the water pricing behavior of governmental agencies and administrative dicta originating in other parts of public groups includes a wide variety of water pricing methods. Several federal agencies among them the U. S. Bureau of Reclamation, have well established policies governing their water pricing practices. Other public agencies are in the process of formulating such policies and the propriety of particular pricing methods has been the subject of considerable argument". The development of relevent criteria and their application of specific pricing alternatives constitute the main theme of Brewer's comments given below:

"Several quite different publics often participate in water development. Federal agencies, federations of districts, counties and local water districts, all may be involved in the impoundment of water, its transportation and distribution to eventual consumers. Water rates and/or water committments are transferred through this chain of organizations. Five pricing methods are now analyzed which may be used in the transfer of water from a regional distribution system to local groups. These latter, in turn, provide the necessary physical facilities and the administrative organization for subsequent distribution to individual users. 'Regional agencies' thus may be regarded as a water wholesale body and 'local' groups as retailing entities.

Proposals of the State of California to construct finance and administer a state-wide water development plan are used for illustrative purposes.

These proposals envisage the contracted delivery of water from the State's aqueduct system to local organizations of which the California Irrigation District may be considered the prototype. These local districts in turn will serve the members contract water through their own distribution facilities.

A state water pricing method explicitly defines the conditions for water exchange between the state and the water districts. Although this exchange represents a 'wholesale' transaction, the conditions which are established influence the financial position of local districts which in turn bears upon the 'retail', pricing methods they employ and thus affects the utilization of the water by eventual consumers. An understanding of the functions of price throughout this process of water transfer is basic to the indentification of relevent criteria whereby the adequacy of alternative methods may be assessed.

The first section of this note describes the structure of the California water 'market' and analyzes the role of price therein. Several different pricing methods are evaluated in the second section. This functional evaluation is extended to embrace broader policy considerations in the third and final section.

The water market and water payments:

The water industry and market

By economic convention the term "water industry" refers to firms which produce water. When a heterogeneous resource is involved, however the term raises a number of problems. Water presents a broad qualatative spectrum, from sewer allfuent to a chemical distillant, and its classification for purposes embodies a broad criteria. Classes I and II water are specified by the Bureau of Water Reclamation on the basis of probability of annual delivery whereas some districts differentiate 'treated' from 'untreated' water and others make a distinction on the basis of elevation at points of delivery. The availability of water from a particular source for given users and uses is partially determined by such institutions as water rights law and water organizations.

The producing firm within this industry also presents conceptional difficulties. The water industry is concerned with a regulated flow of usable water. Here again, significant institutional qualifications exist, for such development must not illegally violate existing rights to water use.

A market is defined with respect to the interaction among buyers and sellers. Properly described, it identifies the process of tenure transactions from producer to consumer, institutions facilitating this process and the conditons of exchange or the exchange ratio prevailing at a stage. Qualification to convential usage of this term are immediately apparent.

Producers and sellers of water are not numerically equivalant. Some producers exclusively wholesale water, as though the U. S. Bureau of Reclamation through the Central Valley Water Project. Others are both wholesalers and retailers, as the local irrigations districts. Approximately 60% of California's irrigation water supply is consumed by producers without direct recource to any form of water market. Most of this is pumped ground water and supplemental to other available sources.

Price and the Water Market:

The meaning of 'water price', or more properly 'water payments', may be examined within this context. Payment transactions between local agencies and their members may vary in time and form.

Direct water sale receipts might, in connection with these transactions, comprise only a part of the total revenue that might accrue to the local agency or state. For local districts assessment and the transfer of funds representing service for the payment other than water supply are additional revenue. Thus total revenues to both the district and state may take the form of (1) receipts of water sale as specified in contracts or by a district board of directors. (2) assessment receipts and, (3) funds transferred by other activities of the distributing unit.

From these revenue catagories a distinction may be made among three steps substantial problem areas: (1) price (2) payments, and (3) financing. Price problems refer to the processes behind the accumulation of sales receipts. Payment refers both to the sales receipts and assessment receipts and accounts processes they involve. Financing is most general, referring to all three catagories of revenue.

Evaluative criteria are needed to assess the several pricing methods considered. These criteria must permit preference ordering of a set of alternatives. They may be specified on the basis of a priority value assertions, or from a pragmatic approach to the process itself. Public pricing policy is manifest through legal and administrative institutions which can be appraised relevently by an examination of the functions with aid of an appropriate criteria. The plural functions of water payments imply separate criteria for each level at which the costs or revenues inherent in payment procedures are incident. Three levels are suggested by the market: regional, local and the consumer.

Payments at the regional level:

The basic economic purpose of a regional plan of water development is to facilitate continuous enlargement of the real income of the respective region.

A number of conditions and constraints surrounding this basic objective are important. (1) no reduction in the state's credit position. (2) payment by beneficiaries and (3) a prevention of unjust enrichment". Due to time and space limitations, these criteria will not be expanded in this report. Brewer continues:

"Payments of the local district:

The ability of local districts to change the size and composition of member payment provide them with a tool for achieving water allocation objectives as well as a source of revenue. The composition of member payments has direct bearing on the district's financial position as the certainty of income streams from different forms of payments varies.

Although specific payment decisions will depend on particular attributes of districts, general criteria may be ascertained.

The provision of water at least cost to members is a prime constituent interest. In this regard, the non-profit nature of the districts, their power to issue bonds, and the technical economics of large scale development and distribution facilities are advantageous of the form of organization. When districts are so constituted that physical interrelationships among different water resources used by its members entail joint costs, district pricing practices, although directly related to district water deliveries alone may also affect the cost of obtaining water from other sources. Under such circumstances, district water pricing may be evaluated in terms of the entire water system available to members. Retail pricing practices may result in different charges to individual members for similar amounts of water. Being unable to disassociate from the organization at will may give rise to factions or dissention groups. In several situations the development of such factions within California irrigation districts has resulted in the replacement of district wide development programs by smaller, localized units organized and financed by individual improvement districts within the same apparent irrigation district. The extent to which different pricing practices avoid equity problems may thus be posited as a relevant and internal evaluated criterion.

(Additional criteria relate to effects of pricing on districts solvency and to the security of the district's water rates).

Payments and the water consumer

The type of payment adopted by a district for its members shapes its water use decision. The district assessment may be considered a fixed cost for annual production decisions as it is customarily based on an unimproved property evaluation and tolls of different sizes will induce the different quantities of the supply.

Often additional non-cost allocating devices are used. Prorating methods of water rationing for those used in which effective water demands exceeds supply have been adopted by most water districts. In spite of these provisions the direct consideration of water costs in production decisions renders the payment schedule in allocating to local water supplies.

Economic analysis of pricing methods:

A pricing method is considered to be general formulation of price.

The methods discussed do not establish a numerical price by themselves: However, they do identify the major variables in a price function and are susceptable to comparitive evaluation.

Although one can conceive of innumerable major vadables about which a price function may be defined, three factors stand out as having been dominantly variable to public water pricing decisions: location of deliveries (in relation to the head of a surface distribution system, the type of use to which the water, and time.)

Price may be systematically related to any and all of these variables or it may be functionally unrelated. It is not necessary to analyze each of the possible combinations. Five specific pricing methods are considered:

1. Postage stamp pricing
2. Differentiation by types of water use
3. Zonal price differentiation
4. Price variations at the time
5. Benefit pricing

Of these the first four have been discussed widely in connection with public water development projects. As defined, these methods are not all necessarily exclusive. Several may be used conjunctionively.

Each of the methods discussed is appraised by reference to the functional criteria developed in the preceding section as well as by more formal criteria of economic efficiency.

1. Postage pricing - This pricing method is characterized by an identical price for a given price throughout the area. The principle exponent of postage stamp pricing for water is the U. S. Bureau of Reclamation. Within a Reclamation project the same price is charged recipients (either districts or individuals) of water or agriculture proposed from any point of the distribution system. Similar practices have been considered for a state water pricing policy. This pricing may be evaluated both from formal and functional standpoints.

Establishing a single price for a public service raises the problem of how the charge is to be determined. Federal reclamation projects determine a cost designed to generate sufficient water sale of the revenues over the projects life to cover that part of allocated project costs termed reimbursable. Federal accounting procedures frequently entail a write-off of certain reimbursable costs by fund transfer in multiple purpose projects and by using interest free capital. A fundamental theoretical controversy between incremental cost (or marginal costs) and average cost pricing has always existed.

Under certain conditions, economic theory demonstrates, that marginal cost pricing will result in an efficient allocation of goods so priced. Whether or not a similar case can be made for the price of water has been subject to question in the literature. Certainly the instantaneous, competitive economic model has desirable attributes. But is it applicable to water? Water development units are hardly competitive in the way required, nor are the factors used perfectly divisible, permitting a situation in which no price would be possible such that it equals simultaneously marginal cost and average cost.

The central shortcoming of this pricing argument is that situation characterized by discrete change are represented in marginal terms. So long as a single factor is not perfectly divisible all the time, losses occur under a marginal cost price.

Average cost pricing has been another single price argument. This argument has been questioned on the basis that some of the factors included in average cost pricing are fixed costs and that their inclusion prevents optimum welfare conditions.

Other attributes of the postage stamp pricing are important for a functional evaluation (e.g. distribution cost are average and considered the same for all users).

From an operational standpoint a postage stamp pricing method offers few problems. Requirements for its application are delivery data and water use categories represented by contracting districts.

2. Differentiation by type of use

There is broad precedent for pricing water by type of use. The U.S. Bureau of Reclamation differentiates between municipal and industrial water and irrigation water from the Central Valley project. Many irrigation districts employ domestic water rates different from those covering irrigation water service. Public utility commissions repeatedly have upheld rate differentiations on the basis of various costs of serving different uses.

From a regional standpoint of differentiation of price among types of water use appears to enhance real income through optimal allocation if the difference factor is made proportional to the respective marginal valued products of water in each use. If reliance can be placed on profit maximization motives of individual water uses, this pricing tool would make higher charges incident from those most able to meet them. This would strengthen the credit position of the state to a greater extent than would be true were postage stamp pricing adopted.

Differential pricing by use requires a basic classification of uses. It may also be possible to classify users within each type depending upon available data.

In discussing the relevency of this pricing tool for the California Water Plan, two positions were advanced regarding the area over which such a differential price might be applied. One maintains that given differential be made applicable for the entire state; the other argues for differentiation among users by differing regions.

Because charges for agricultural water traditionally have been less than those for either domestic or municipal and industrial use, selection of the area within such differentiation is effected has important cost incident consequences. The larger the relative quantity of higher priced water for non-agricultural purposes, the lower the price of agricultural water for a given regional revenue target. A related corollary lies in the economic shock-absorbing effect of the higher priced water uses. The price for agricultural water would tend to be less sensitive to changes of a regional revenue target.

A second regional advantage attached to use of the property assessment-component of the retail water payment complex. Differences in property valuation systems for California irrigation districts have been used effectively to change the incidence of total district costs (which may consider total water costs) towards urban areas. So long as local contracting agencies have member assessment powers the favorable tax base of areas such as Southern California may be used to reduce the portion of total cost per acre-foot of delivered water paid by agriculture.

Contractual stipulations are required to assure effective compliance at the retail level with water payment differentiation designated by a regional authority. Two difficulties immediately present themselves at this point; the reduction in district pricing flexibility entailed, and the substitution of water from different sources within this district as a way of avoiding such retail stipulations.

Local irrigation districts have many factors to consider in determining retail payment schedules. One such consideration relates to the management of the system of water available to the area served by a district. The payment complex may be used in a manner designed to induce its use of a particular combination of water sources within the district consistent with the criterion of lowest total cost water over relatively long periods of time. Frequently such water management programs entail the integration of ground water pumping with surface water use. As both the assessment and water toll components are administratively determined by the district, the variable unit cost of district water might be set in any desired relationship to the comparable cost for pumped ground water. In this manner, ground water may be rendered either a prime source or one supplemental to the district delivered surface water.

A second operational difficulty stems from the substitutability of district supplies. When other water sources are available not encumbered by contract, a substitution of sources for particular uses could render this pricing method ineffective.

To those considerations should be added the fact that districts are public bodies. The efficiency with which a district operate - establishes mechanisms for decision making, assembles a competent staff, obtains a degree of member consensus to permit the implementation of management programs, etc. - is related to the stability of the organization and its executive body. This stability has been the major consequence of the evolved equilibrium between the political and the economic forces internal to these organizations.

The effects of different tools of the state water price policy on the district's future organizational viability merits substantial consideration. A frequent basis for the separation of district members into factions is the type of water use activity in which they are engaged. Many districts have found that the expansion of initially small urban centers around their boundaries require a major re-adjustment in the operation of their water systems pricing arrangements and, in some instances, precinct redistricting for election purposes. The problems encountered and solutions pursued are unique to each individual district. A program of water price differentiation by type of use to the extent that contract stipulations require the adoption of new internal arrangements within the district, undoubtedly would meet with district opposition and would place in jeopardy the political equilibrium they have evolved. Thus, although partial analysis indicates an increase in economic efficiency by such practices, its overassiduous implementation might disrupt local districts at substantial social and economic cost." Thus, this price discrimination by type of use is a method of water pricing that consists of charging different water rates to different types of users, where a difference in price is charged for the same basic product even if treatment, distribution and service costs are subtracted for all uses, a difference in price still exists. A rate differential by itself implies that certain water uses are being favored at the expense of others and economic efficiency is not being attained, although political factions may be satisfied.

Discriminatory water pricing is a result of early government aid for the development of the western United States. Because charges for agricultural water have traditionally been lower (as a result of repayment obligation subsidies) than charges for municipal and industrial water, a broadly applied precedent for pricing water by type of use (particularly irrigation water) has been established.

It is time that under this method, total project costs may be repaid by users (rather than by national subsidy), but unless there is the delivery and distribution and service costs forthe cheaper use (usually agricultural although in some cases industrial) the other users (usually domestic and industrial) end up subsidizing agricultural entrepreneurs.

3. Zonal Price Differentiation

Proposals for zonal differentiation of state water price for the California Water Plan had been made under the general heading of the Delta Pool Concept. This concept differentiates between the production and the distribution phases of the regional water plan. It entails the designation of average acre-foot charge for the water at the delta of the Sacramento and San Joaquin Rivers which subsequently is transported farther south by the California Aqueduct system. Zones are to be established along the Southern course of this distribution system within which a single water price would prevail for contracting entities. A zonal acre-foot cost would consist of a charge based upon the cost of facilities required to deliver the water to each zone in addition to the designated delta charge. Aqueduct costs are to be allocated to each such zone on the basis of proportional use of facilities. The separable cost-remaining method, generally adopted by Federal Agencies for cost allocation among different project functions, holds distinct advantages.

Use of this separable cost reminding benefits method would allocate larger proportions of joint benefits to southern California than to the San Joaquin River Valley area. This is due to two attributes of the regions. First, the temporal bunching of irrigation demand required a larger capacity structure per acre-foot delivered annually,then the constant demand of municipal and industrial water which composes a hard proportion of anticipated southern California demand. Second, the relatively larger share of total benefits accruing to Southern California does not tend to decrease the portion of total joint benefits accruing to Southern California under the proportionate use of facilities mentioned.

A number of technical problems, however, accompany this proposal. For example, if a zone north of the most southerly zones used indicates an unwillingness to contract for amounts of water adequate to assure receipts to the regional authority equivalent to costs, does this influence the size of contract payments to the more southerly zone? Are these excess costs to be amortized over all potential zones along the distribution system?

This eventually appears distinctly possible, especially if differentiation of price among different uses is made by local agencies. The M.W.D. of Southern California already has existing mechanisms for such a differentiation, effectively shifting costs incidence to urban or industrial areas by ad valorem property assessment.

The willingness of Southern California municipal and industrial water users to pay their part of the cost of agricultural water doubtlessly reflects their desire to establish current use of this water. It will be available to the entire region at some point in future time when a substitution of expanded municipal and industrial water uses for former irrigation use is anticipated.

4. Price Variations Over Time Method

The initial financing proposals for the California water plan envisaged the issuance of 50 year general obligation bonds. The length of delivery contracts is 75 years. A variable acre-foot charge for contracted water during this period has been proposed. This proposal reflects the desire to receive payment committments adequate to assure project solvency prior to state construction, on the one hand and uncertainty with respect to actual construction costs and immediate effective demand for state water on the other.

To the extent that a variation of contract price is passed on by a district to its members through the payment complex, contract water assumes cost attributes for the eventual consumer similar to those of pumped ground water.

From the standpoint of contracting districts, some guarantee is needed to assure that solvency can be maintained under a flexible price contract. Prior to contracting for water from a regional water development program, a district's future water demand must be predicted. Districts anticipating an expansion of current demand, as the result of either members substituting additional surface water for presently pumped ground water, or the expansion of irrigated acreage within the district, will attempt to contract for a quantity consistent with estimated future demand.

If the average acre-foot payment of the district to the regional authority increases to a point at which the associated internal payment complex removes the inducement to expand internal irrigation, the district would have overcontracted in terms of effective member demand. Under such conditions it would have to sell whatever possible of its excess water to non-district entities. Non-district demand for such water generally would tend to be lowest during those times when the largest surpluses would accrue. Failing to dispose of its excess water by non-district sales, the additional revenue to the district needed for contract payments would have to be exacted by members by increasing either the water toll or assessment or both. Thus, such a pricing device conceivably could result in a higher cost for water to individual water users than would be the case under a fixed contract payment.

Variation of price over time would, however, provide the regional authority with a means whereby adjustment of individual enrichment from public water development will be achieved continuously.

5. Benefit Pricing

The final pricing method to be examined is one based upon benefits received. Conceptually it requires knowledge about the demand function for water; and in application it entails prices resembling those of a perfectly discriminating monopolist. So long as the demand functions of separate local districts are not equally elastic with respect to price, sales receipts are maximized by this pricing method. Financial solvency of the state is increased by such a benefit pricing system because offers to contract will be conditional upon the relationship between the established price and value attributed.

However, the magnitude of benefits is difficult to estimate and subject to change.

This method would also localize charges on beneficiaries. This generally is consistent with the prevention of unjust enrichment.

At the local level this method may result in limiting the flexibility of internal district pricing arrangements. Extreme interpretation of benefit pricing also entails associated problems relating to the regional authorities' ability to ascess the value of water to individual district members or internal groups.

A more moderate interpretation considers each district to be a production unit to which a unit water benefit may be imputed. This appears the most feasible manner in which the water benefit method can be appliced. It would provide the basis for contract payments from individual districts and would leave them their present flexibility in using the payment complex for internal pricing arrangement. The availability of approximate benefit measures argues in favor of using the district as the unit for analysis as well as administration of such a pricing method.

The value of benefits may be taken as a weighted average of benefits or marginal value product to individual water uses and users occurring within its boundaries.

Under benefit pricing arrangements, the price charge presumably will assure a ready local market and reduce the tenure on district water from sources other than by contract.

A further advantage from the district standpoint of such a pricing method is that the direct link with benefits implies an automatic price adjustment keyed to the particular phase of the business cycle prevailing at a given time."

Thus, under benefit pricing,prices would just equal the benefits which water users receive from the water supplied. A thorough knowledge of the demand function is necessary to establish such prices. However, even if a current demand curve could be established, the problem of evaluating current benefits needs to be solved. This evaluation is complicated by the fact that the benefits received may change with changes in water or land use. This requiring a new price to be set commensurate with the new benefits.

Benefit pricing does eliminate unjust enrichment as users are charged for the benefits they receive, however in this monopolistic type of situation economic feasibility (is total benefits received exceeding total costs expended) is not immediately established.

The conclusion is drawn that benefit pricing is generally unacceptable unless supplemented by an intentional subsidy.

Before concluding this section on pricing method two special examples of a fixed price scheme will be discussed mainly in theory namely, average and marginal cost pricing.

Average Cost Pricing

This method of pricing allows a single price for all water uses to be set for a given project or by a given supplier when such a price is the average cost of delivery, being the sum of construction, and operating and maintenance costs and a return on the public's investment. Furthermore this method, by design, ensures financial feasibility provided sufficient demand does actually exist.

Thus, it may appear at first glance that here is a equitable method of water pricing having the attributes of case of practical application, recovering all incurred losts with interest and not discriminating or subsidising any one user.

However, this method, except under rare circumstances (which will not be covered here) will not result in efficient pricing with optimal water use. Because the average cost water supply increases with the level of water service the associated marginal cost also increases but at a greater rate. Hence, if the level of service is determined where demand equates average cost then the marginal cost for that level of service will be above the average cost. It follows therefor that the last units of water delivered which cost the marginal cost of delivery are being used inefficiently as they are being only charged the average cost which is lower. It is thus possible for the public to be (unconsciously) subsidizing private water users even though one price is charged, because the marginal cost of supplying some user is greater than the value of the water to that user.

Marginal Cost Pricing

This method of pricing also established a single basic price for all users but price is set equal to the marginal cost or ie. the cost of developing or providing the last increment of service to users.

This pricing method will result in economic efficiency and optimal use of the water. It has the disadvantage that a revenue surplus is developed, however this surplus may be returned directly or indirectly to users.

A surplus revenue will only result in the short run where marginal cost is above average cost. Surplus revenue under marginal cost pricing actually means that expansion is economical ie.- the demand of users is such that their willingness to pay for an increment of extra service excludes the cost of providing that increment. In principle efficient pricing should be at the short run marginal cost rather than the long run marginal cost. This may mean that on expansion a deficit may occur until demand increases sufficiently to meet the full capacity of the new increment, which because of practical scale of operation limitations may exceed the initial demand at the new marginal cost.

Surplus revenue, if necessary may be disposed of by direct reimbursement to users based on a equal rebate to all users or indirectly by either providing expansion of new supply facilities or providing recreational or other public benefits which are able to be used by the entire community who are usually all purchasing water. Of course it may be pointed out that all water users may not desire the recreation or other benefit provided.

Nevertheless, an equitable surplus revenue disposal procedure is not a difficult task to solve.

A practical difficulty in application is establishing a total deman schedule for water for all users. As water is not a perfectly competitive consumer good (eg. legal transfer restrictions,etc.) its response to price variation cannot always be properly determined. Yet, notwithstanding further difficulties such as tradition and administration a pricing policy which is at least related to the marginal cost pricing concept can be hopefully approached.

The short run average and marginal cost curves can be established for all users by simply calculating the capital construction amortized costs and the operation and maintenance costs. Notice that the marginal cost of providing the last increment or developing an extra unit of supply, may not be the same for all users because of different user distribution and service charges. However, the basic marginal cost of total supply and individual marginal cost uses adjustments can be determined.

Similarly a short run demand curve can be determined by establishing a demand - (ie. quantity at a given price) schedule, (respective quantities for a full range of prices). This information can be "dug out" by survey's questionnaires and reviewing the results of prices changes on quantity taken for other district of similar character. Thus, in the short run, a pricing policy aimed at current marginal cost is a realistic goal in as far as true marginal cost can be determined and in that it is at least capable of approximate achievement. Further the economic optimal pricing procedure, namely that of pricing at marginal cost is then at least the policy of the agency and so true economic efficiency which is one important measure and guide of social welfare is the stated and recognized goal of the public agency.

Pricing Methods and Water Policy

Returning to Brewer "The close relationship between water pricing and a number of important water policy issues may be made explicit by considering three major areas of water policy issues: project evaluation and selection, financing and repayment, and water law and

and organization. Water pricing is but one aspect of the second category, yet is closely interrelated with the other two. Pricing thus is not an isolated matter to be resolved after other policy decisions have been made.

Public investment activities can be justified by the failure of private investment actions to satisfy social criteria. The composition of the private investment its aggregate size or its timing may be inconsistant with these criteria. Of the several causes for this failure that have been indicated, two are of immediate relevance to water pricing methods. These are price signal failures to indivisible proprietorship and differences between public and private time preference rates.

Proprietary Indivisibilities

Indivisibilities in water ownership may be of two types: indivisibilities in quantities and over time. Both exist in most non-negotiable contracts. Reduction of these indivisibilities facilitates proprietary transfer and thus potentially enhances the efficiency of the resolving water allocation.

A reduction of these two types of indivisibilities at the wholesale level may be considered to be an increase in the negotiability of water delivery contracts. Such negotiability bears directly upon the problem of water transfer in connection with secular economic adjustments of agriculture. It would permit water delivery contracts between the regional authority and local district to be sold.

Similarly a legal transfer of liability for payments to the state during the remaining life of the contract would require agreement of all parties. Particular advantage is seen from the standpoint of facilitating adjustment among water - using activities on the one hand and water organization on the other. That is, the proprietary interest may be shifted as different forms of local distributive organizations appear more suitable in light of future changed in the pattern of water use. Negotiability would be a deterrent to unjust enrichment problems if coupled with a centrally imposed contract transfer assessment.

An increase in negotiability will also tend to strengthen the credit position of the regional authority. It would facilitate the transfer of active contracts from organizations financially insolvent to others with a stronger financial position and thus considerably strengthen the collateral for future contracted payments to the authority.

This is particularly important in light of the anticipated population expansion of California during the next 50 years and attendant adjustments in water use that will accompany this growth.

Two aspects of this adjustment are significant: (1) The adoption of new forms of organization and (2) the changes in the financial base of local districts. Past experience of California irrigation districts evidences the difficulties of using this form of organization to construct, finance and administer extensive systems of domestic water supply as most of these districts had assumed an initial function of providing irrigation water service.

Difference between Public and Private Time Preference

The aggregate nature of a region defined as consistant with the regular authority, may be characterized by time preference rates that differ from those of the largest private investment agents within the region or to the weighted average of such rates of all private investment agents therein. It is further accepted that changes in public time preference differ in magniture time, and possible direction from private rates.

Without the means to specify the character of the differences - and they must be so specified as must the changes in external influences on prices for optimization of the public private investment mix - one might point to the need for project flexibility. This flexibility may be included through physical project design as well as through administrative and operative practices."

Conclusions

Pricing policy proposals must be made as accomodating to future changes in patterns of population and economic activity that will permit the integration of the administration of the California Plan and local district objectives into the broader scope of economic planning.

Beginning
Section 3

SECTION 2 - PART C: A Collection of Related Notes

Note 1: Willingness to Pay & Price Discrimination

This note is an abridged extract from Chapter 2, "Objectives of Water Resource Development," by Stephen Marglin, of "Design of Water Resource Systems, Maass, et. al.

"To exploit willingness to pay is to employ one or another of the forms of price discrimination listed previously. The use creates administrative difficulties for any deviation from the policy of charging the market clearing price leads to such problems. The nature of the difficulties stems from the marginal conditions of efficiency maximization themselves: that the amount of money each consumer would be willing to pay for an extra unit must be the same. The logic behind this condition is straight forward: for a design to be efficient outputs must go to those who are willing to pay the most for them; that as long as the margin willingness of individuals to pay differs, units of output can be transferred from individuals with lower marginal willingness to pay to individuals with lower marginal willingness to pay to individuals with higher willingness to pay, thus increasing the overall willingness of beneficiaries to pay. In theory price discrimination can be imposed in such a way that each individual will be willing to pay the same amount for an extra unit, but this would require such precise knowledge of individual demand curves and so extensive a collection apparatus that it cannot, in fact, be accomplished. To be practicable price discrimination must be applied to groups rather than to single individuals and such classification schemes inevitably group individuals with different schedules. Under price discrimination it becomes operationally impossible both to place outputs in the hands of individuals who will pay the most for them and to exploit fully the willingness of individuals to pay. Price discrimination is thus compatible neither with the efficiency maximization nor with complete redistribution of the gains of the original beneficiaries of another group."

Note 2: Cost Allocation & Rate Making

This note is an abridged extract from "Cost Allocation in Relation to Western Water Policies", by S. V. Ceriacy - Wantruh, Chapter 12 of "Economics & Public Policy in Water Resource Development" edited by Smith & Castle.

"Theoretically the problem of separating water or power can be approached with tools similar to those used in determining the optimum product combination. A demand and supply function for water and power must be constructed from the standpoint of social economics a demand function can be interpreted as a marginal benefit function and a supply as a marginal cost function. On this basis an optimum dated product combination can be determined.

"Rates can be set in such a way that supply and demand in each time interval are in equilibrium. Rates for private industry must be set in such a way, first, that the optimum product combination results and second that supply and demand are in equilibrium in each time interval. To obtain these two results, rate making may have to be supplemented by tax incentives for example by provisions to depreciation allowances.

"Such are not necessarily equal to short run or long run marginal costs of instantaneous economics.

"It will be naive that in a field so exposed to political pressures like the files of rate making, considerations based on economic theory will be only one (decidely minor) factor in political decision making in some time to come."

Note 3: The Economic Approach to Demand

Before concluding this section one term which is confusingly used in the literature of water development, namely the use of the word "demand", should be clarified, as demand and price are very much interrelated as has been indicated earlier in this section.

*Economic demand can be broken down into two parts - desire and purchasing power. It can be assumed that a desire for water exists. However, when water is used in a production process the desire to satisfy a basic need is replaced by desire for profit. In this sense, desire and purchasing power are limited by the ability of the resource to contribute to profit.

As outlined, the economic principle that prescribes the most efficient use of a factor of production may be expressed as follows: If the net returns from adding one more acre-inch of irrigation water on a crop is worth $2, then the maximum price the farmer will be willing to pay for an acre-inch of water is also $2.

This does not say that the price to be charged should be $2. It says that at the margin, i.e. of adding one more additional acre-inch of water the value of the marginal crop product is $2. The price to be charged for the marginal acre-inch of water is the highest value of marginal crop product that can be produced by the utilizing last acre inch of water, provided always that economic feasibility has been established, i.e., that at least one or more of the prices willing to be paid for the marginal water quality exceed the cost of providing the last unit of marginal water.

In his paper Moore found by using a linear programming model approach** to farms on the eastern side of the San Joaquin Valley, California, that as the price of water was increased, new combinations of crop became optimum, and it was thus possible to trace the most favorable quantity of irrigation water to be used throughout the entire range of water costs he considered.

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*Part of this note is largely based on C. V. Moore, "Economics of Water Demand in Commercialized Agriculture," Journ. AWWA, Vol. 54, No. 8, August, 1962.

**In brief, linear programming is a mathematical method of determining the optimum combination of production alternatives subject to quantifiable constraints.

The results of Moore's study showed that commercial farm demand for irrigation water is relatively inelastic (i.e. an incremental increase in price causes little reduction in quantity taken and total revenue from sales will increase) in the lower price ranges and becomes progressively more elastic with increasing prices. From this it can be concluded that water agencies suffering irrigation water can increase total revenue (e.g. for additional structures) by small price increases and so approach greater efficiency (Note: redistribution effects of increased revenue and subsidies are being neglected, i. e., efficiency also depends on viewpoint.)

Another interesting finding was made by Moore in regard to storage value and its price component for irrigation water in terms of the additional amount farmers would be willing to pay for available supply variations through the year - i. e. whether the value of acre foot of water in July is the same in May. The contention here is that under conditions of restricted supply (when ground water pumping is limited to the safe yield of an aquifer), surface water that is made available later in the growing season will increase farm income. Further the amount of increase in farm income, from the base time period (no storage) to succeeding time periods will determine the value of storing this block of water and hence provide a basis for any additional price temporal adjustment.

Note 4: Demand and Pricing Policy

It is common government water agency practice to determine proposed project benefits based on current and future projected "demands". This method of evaluating project benefits (thence project economic feasibility) is a faulty one because, with the exception of inelastic inferior goods, demand is inseparably a function of price. It follows, therefore, that price must be considered when determining demand and (for economic efficiency) vice versa.

The following definition of price* helps to explain this concept further:

Demand is "an expression of the various quantities of an economic product that can be sold (i. e. will be bought) at various corresponding prices under given market conditions at a particular time."

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*due to Stanford Research Institute

(The above definition gives rise to a total demand schedule for the particular product under consideration.) "Demand is thus not a "requirement" or a "need" computed without regard to either price or market conditions; moreover, the quantity of it that can be sold generally decreases as price increases and vice versa (i. e., the product is elastic). Indeed, the quantity of a project's water that can be sold at one price is usually (particularly for agricultural uses) far different from the quantity that can be sole at an appreciably different price."

Note 5: Groundwater, Pumping Tolls, and Surface Supply

The note was taken from "Economic Factors in Kern County Water Agency Policies", Stanford Research Institute Report, September, 1964.

The application of a pumping charge, (a rate per acre-foot), has the effect of pricing ground water to users according to the rule developed earlier for obtaining the maximum net output from use of water. Each user is charged the same base price (the pumping charge); each user bears the cost of transporting the water to him (his own direct pumping cost); and the base price (the pumping charge) is set at the level that will just cause the users to take the available supply (safe yield). The earlier detailed derivation of this rule explained why it achieves the maximum net output.

Once the pumping charges have been collected, they have performed their economic function of allocating a limited supply of water to the most productive uses to which it can be put, and of protecting the ground water resource from exhaustion, thus preserving it for perpetual use in the future. There is no need to withhold these funds from the farmers, and they may simply be returned or devoted to any appropriate use. Only one restriction must be placed on the method of distribution. If the money is refunded in relation to the amount of ground water pumped, this amounts to a direct rebate of the charge and will negate the effect of the charge on pumping decisions. Any basis of distribution that is not related to the amount of ground water pumped will still permit the purposes of the charge to be fulfilled. For example, the funds could be distributed among farmers in proportion to the average annual amounts they pumped before the charge went into effect. Or they might be applied to obtaining additional water or building distribution systems.

Underpriced Surface Water Supply. It is clearly to the advantage of the farmers and also to the advantage of the community to stabilize the ground water at safe-yield operations rather than to exhaust the aquifer when this can be done by negotiation or a pumping charge.

Both of these methods involve little in the way of costs in order to achieve the perpetual use of the safe yield. An adjudication would no doubt be more costly to accomplish, and its one-time costs would have to be weighed against the long-term benefits from preserving the water supply in determining whether it is economically worth while. The remaining method that could be used to bring about safe-yield pumping of the ground water involves significant perpetual costs to the community, and there is no *a priori* reason to conclude that its application would be preferable to simply allowing the ground water to be used to exhaustion in case the farmers are unwilling to undertake cooperative action in their self-offering surface water at an artifically low price to the farmers in order to induce them to pump less ground water. This is the method that KCWA appears to be proposing.

If imported surface water is sold in the ground water area at a price below that indicated by the rule described earlier, it is apparent from the discussion of the equimarginal principle that this means diverting water from uses in which its value is higher to uses in which its value is lower. This represents a net loss in output to the community.

A further effect must also be noted. When the underpriced surface water is offered, those ground water users with the highest pumping costs will be the ones who find it profitable to substitute the surface water for pumping. This means that the users who continue to pump and to utilize the now protected safe yield of the ground water basin will be those with the lowest pumping costs. Since they will consider only their private pumping costs in planning their use of the water, they will apply it until the value produced by the marginal acre-foot falls to the cost of pumping. The value produced by the marginalacre-foot of ground water will therefore be even less than the already artificially low value produced by the marginal acre-foot of underpriced surface water. Thus the scarce resource (ground water) that efforts are being made to preserve would be directed to its least productive uses. This represents a further loss of output to the community as compared with what could be obtained through application of a pumping charge to stabilize the ground water and sale of the surface water at the market-clearing price.

In view of these associated costs, stabilizing the ground water basin by underpricing a surface water supply could conceivably, but by no means certainly, result in larger net output than allowing the ground water to be exhausted. The outcome would depend on the amount of the safe yield protected and the productivity of its uses versus the amount of surface water sold at cut prices and the productivity lost by diverting this water to lower valued uses. Only a detailed analysis of the specific situation in the ground water area and in the areas from which the water would be diverted could provide guidance on this problem. Even if it were found that a net gain would be produced, it is certain that an even greater net gain would be produced by one or more of the alternative methods for stabilizing the ground water basin. It is therefore concluded that, in terms of providing maximum economic output in the community, no basis for underpricing imported water to prevent exhaustion of ground water has been established.

The same S.R.I. report showed that, at least in Kern County, the available supply could be sold at higher prices than KCWA had proposed. In other words, the market-clearing price is higher than the present asking price. Therefore, selling the water at the market-clearing price would lead to increased economic efficiency in water use.

Note 6: Cost Recovery through Water Sales at a Single Price*

Ideally, there is a single per-acre-foot price at which revenue generated as a result of the sale of water over the entire economic lifetime of the project will exactly cover the costs which will accrue during the economic lifetime of the project. The use of such a single price, however, has certain disadvantages. During the years immediately following the completion of the project, and while demand is developing, not enough revenue would likely be generated through the sale of water at this price to cover the annual fixed costs. Beyond this, demand may develop less rapidly than predicted (or it may never develop at all), with the result that the total costs of the project will never be recovered through the sale of water alone.

One approach to this latter problem - an approach generally followed by the Bureau of Reclamation (as will be explained in more detail in Section IX) -- is to specify in advance of project construction that water users must agree to purchase certain minimum quantities of water regardless of the quantity of water actually demanded at the established price. By prearrangement, moreover, the minimum quantities could be increased periodically so as to parallel, at least roughly, estimates of increasing demand. In effect, the water users would be committing the quantity of water actually delivered. These minimums would be so established as to ensure full cost recovery over the lifetime of the project.

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*Note inherently involves consideration of the State's determination of repayment obligations. The note is an extract from "Economic Considerations in the Formulation and Repayment of California Wat Plan Projects, S.R.I. Report, 1958.

A second possible price is one which would just cover operation and maintenance costs until full capacity operations are reached. It is a principal of welfare economics that it is wasteful for government to attempt to recover the fixed costs of a government enterprise if to do so would involve charging a price which would reduce the quantity sold below what could actually be produced. Since the output is available, whether or not fixed costs are recovered, this would mean that the State would attempt to i.e. recover only operation and maintenace costs during the period of demand build-up if charging part of the fixed costs would decrease the quantity of water used.

But this approach would involve bookkeeping losses at least until full capacity operations are reached, at least temporarily it might also cause the water provided by the State to displace existing water sources which the State intended to supplement rather than supplant.and this approach would require adjusting its price upward, perhaps drastically and with unsettling economic consequences, after full capacity operations have been attained.

Another approach would be to establish at the onset a single price designed to cover costs under the assumption of full capacity operations throughout the lifetime of the project. This policy would have the disadvantage, however, of causing the water program to operate at a loss much of the time--particularly in the years immediately after project construction has been completed.

SECTION 3 - Current Water Pricing Practice

Schedules and Policy of Local, State & Federal Water Agencies.

Part A: Water Pricing Schedules and Policy -- A Collection of Statements and data from some Selected Water Agencies in California.

1. Introduction and Presentation of Data.

The economic theory of water pricing and a general sultine of available pricing methods has been given in Section 2. This was one of the two basic objectives of this study. The second was to collect information on the current pricing practices of some public water agencies. The idea behind this aim was that current practice may exhibit some of the trends in water pricing and reflect the changing patterns of water use. To establish the pricing policies of other agencies was also a parallel objective.

The above objectives seem clearly defined and straightforward and yet the writer soon found that, in the short time available, even a very modest attempt at obtaining meaningful information on current practice particularly policy, was no mean task.

It was decided, in discussion with the writer's superior, to attempt in the first instance to narrow the objective to obtaining 1) the pricing schedules of some selected water agencies with areas and problems similar character to those of Santa Clara and 2) the pricing policies of the State of California Federal agencies.

To investigate a large number of Water Districts would have acheived little other than a large volume of data (otherwise unavailable) and consumed more than the whole time available for the study.

There are over 2,800 public and private water agencies serving local areas in California. Within this organizational complex, the agencies vary widely in size, financial capacity, legal authority, and scope of interest.

The private water agencies are of two types: public utility companies (i.e. commercial companies) and mutual water companies. The public agencies are also of two types: municipal waterworks and public water districts. The public district, the agency with which we are concerned herein, differs from all other water agencies in that it itself has powers of taxation, assessment, and eminent domain.

These districts serve approximately 74 per cent of the State's total irrigated acreage 1) and, directly or indirectly, many of its domestic water connections. 2) The existing pattern of public districts has evolved from some 30 general acts and some 40 special acts. 3)

1. About 90 per cent of the water presently used in California is used in irrigation.

2. Though the public districts directly serve only some 15 per cent of the State's domestic water connections, they serve an additional (unknown) number indirectly through their wholesale operations to their memberships.

3. See Analysis of California District Laws, 1954, 1955 (Ref. 144); and General Comparison of California Water District Acts, 1955 (Ref. 109). Note: A chronological listing of these acts is also contained in Appendix A of this report.

* From: "Economic Considerations on the Formulation and Repayment of California Water Plan Projects S. R. I. Report, 1958".

These acts have enabled no fewer than 15 major organizational forms of public district which have the power to acquire and sell water. These organizational forms, together with the approximate present number of districts in each, are as follows: 1)

Community service districts (40) (122 reported in 1963)
County water agencies (2) (23 reported in 1963)
County water authorities (2) (23 reported in 1963)
County water districts (125) (200 reported in 1963)
County waterworks districts (75) (93 reported in 1963)
Flood Control and water
conservation districts (10) (39 reported in 1963)
Irrigation districts (114) (109 reported in 1963)
Metropolitan water districts (1) (1 reported in 1963)
Municipal water districts (28) (52 reported in 1963)
Public utility districts (75) (68 reported in 1963)
Reclamation districts (138) (146 reported in 1963)
Water conservation districts (18) (18 reported in 1963)
Water districts (67) (119 reported in 1963)
Water storage districts (4) (9 reported in 1963)

Both the 1958 and 1963 figures are given to demonstrate the changable nature of these district statistics.

1. See annual Reports of Financial Transactions of Special Districts and 2) Irrigation and W. S. Districts of California or Water Utilization and Requirements of California
   Vol 2 (Note: Because of dissolvements, formations annexations, the number of districts changes continually)

2. Certain of these districts have no authroity to sell water and are excluded.

A subjective list of water agencies throught to be representative and relevant was selected with consultation with the writer's supervisor.

The writer had previously obtained pricing data on six selected irrigation districts from the files of the P. W. R. at Sacramento.

A further 25 water agencies were selected, and a list of all districts selected is given below.

A letter, requesting information on the agency's pricing schedule, particularly the use of a differential price for different uses, and a statement of the agency's pricing policy was requested. A copy of this letter is exhibited in Appendix A. Unfortunately, at the time of writing this report only 10 replies had been received.

The table below lists the districts contacted and summarizes the position of this questionairre and broadly the results of those districts who have replied to date.

LIST OF CALIFORNIA WATER AGENCIES CONTACTED

	Name	County	Reply Received	Rate Schedule	Information Policy Statement	Any Differential-
A.	**California Water Districts:**					
13.	Kings River Water	Fresno County				
16.	Wesltands Water	Fresno County				
11.	Devils' Den Water	Kings County				
12.	Irrune Ranch Water	Orange County				
15.	Brestimba Water	Staneseaus				
14.	Lewis Creek Water	Tulare				
B.	**County Water Districts:**					
1.	Alameda County Water	Alameda	x	yes		no
3.	Buttonwillow County Water	Kern				
6.	King County Water	Kings County				
2.	Baldwin Park County	Los Angeles				
7.	San Gabriel County	Los Angeles	x	yes	yes	yes
5.	Costa Mesa County	Brange				
4.	Coachella Valley County	Riverside	x	yes	yes	yes
C.	**Municipal Water Districts:**					
41.	Central Basin Municipal	Los Angles	x	yes	yes	yes
43.	Orange County Municipal	Orange	x			
47.	Western Municipal Water	Riverside				
48.	Otay Municipal Water	San Diego	x	yes	yes	yes
45.	Ramona Municipal Water	San Diego	x	yes	yes	yes
46.	San Luis Rey	San Diego				
42.	Colleguas Municipal	Ventura				
D.	**Metropolitan Water Districts:**					
	M. W. D. of Southern California			(information is available)		
E.	**Irrigation Districts:**					
51.	Carmichael	Sacramento	x			
52.	El Dorado	El Dorado	x			
53.	Fair Oaks	Sacramento	x			
54.	Glen Colusa	Colusa Glen	x			
55.	Kelix	San Diego	x			
56.	Madera	Madera	x			
57.	Santa Fe	San Diego	x			
58.	Shafter-Wasco.	Kern	x			
F.	**Special Districts:**					
	Alameda Flood Control & Water Conservation		x			
	San Diego Water Authority		x	yes	yes	yes
	Santa Clara		x	x	x	x

										N. K.	(i) no (ii) yes	
Orange County Municipal Water District	Orange	yes	No	yes At present in addition to M. W. D. taxes, a levy of $0.10 per $100 of assessed valuation.	yes		Charges are same as for M. W. D. of Southern California The District from time to time adds an ad valorem tax			A.N.	(i) A. N. (ii) A. N.	1. Obtains supply from M. W. D. of S. C. 2. Justifies differential because of: i. system demand, ii. billing costs iii. Wholesale cost of water iv. Properties in use v. Pumping costs.
Otay Municipal Water District		yes	yes	N. K.	yes		There are six classes of water. Four declening block rates apply to these classes of use Only three classes are given here, for other classes refer to Appendix A-1-a Block — Class A Domestic Service — Class B Industrial and Commercial — Class D Agriculture 0-600 cu. ft. — $0.50 per cu ft. — $0.50 per cu ft. — 0-3000: $0.50 per 100 cu. ft. 601-1,0000 — 0.30 " " " — 0.30 " " " — 3001-6000 27.5 " " " " Over 10 — 0.20 " " " — 0.125 " " " — Over 6000: 0.125 " " " "	——	(i) yes (ii) N. K.	(i) yes (ii) N. K.	A. N.	1. Higher costs than other nearby agencies due to higher pumping costs. 2. Purchases water from M. W.D. of S. C.
Ramona Municipal Water District	San Diego	yes (justified since purchase of water is from M. W. D.	yes (Employed "to encourage water use of a system operating below capacity".	yes $1.80 per $100 of assessed improved valuation.	yes		First 2000 cu. ft. per month @ $0.35 per 100 cu. ft. Next 4000 " " " " @ 0.30 " " " " Next 14,000" " " " @ 0.20 " " " " All over 20,000 " " " @ 0.17 " " " " Domestic @ 0.15 " " " " Agriculture	——	(i) yes (ii) N. K.			
San Diego County Water Authority	San Diego	yes	no	yes $018 per $100 assessed valuation.	yes (acre feet only)		Charges are M. W. D. Rates plus $1.25 per ac. ft. 1. Agriculture: $17.25 per ac. ft. 2. Other: 29.25 per ac. ft.	——	(i) N. K. (ii) N. K.	A. N.	(i) no (ii) (would vary with M.W.D. rate)	1. Transports Water throughout County 2. Additional Toll designed to cover O and M costs 3. Tax used for bond issues and capital repayment charges to Federal government.
San Gabriel Water District		no	yes	no (District free of bonded debt)	yes		First 1000 cu. ft. @ $0.16 per 100 cu. ft. Over 1000 cu. ft. @ 0.13 per 100 cu. ft.	——	(i) yes (ii) N. K.	(i) A. N.	(i) A. N. (ii) A. N.	
All the District below are Irrigation Districts.												
Carmichael	Sacramento	yes	no	yes $0.50 per $100 assessed valuation.	no		AGRICULTURE: $11 per acre feet per year DOMESTIC: $43.50 per service per year	——	(i) no (ii) no	A. N.	(i) A. N. (ii) A. N.	
El Dorado		yes	yes	yes $0.425/$100	yes but not entirely		1. Cts. Flow: $40.80 per inch per season 2. Cum: Flow $40.80 per inch per season 2. Demand Flow: 0.47 per M.I.D. Treated, metered First 2000 cu. ft. $7.50 min. 2001 to 4000: $0.15 per 100 cu. ft. See Appendix A-1-a for other details	50% higher	(i) N. K. (ii) N. K.	A. N.	(i) A. N. (ii) A. N.	
Fair Oaks	Sacramento	yes	no	yes $0.333/$100	no		$9.00 per acre $48.00 per service per year (flat rate)	——	(i) no (ii) no	A. N.	(i) A. N. (ii) A. N.	

Glen Colusa		Agriculture only	no	yes $2.00 per $100	no	General Crops $3.75 per acre. See Appendix A-1-a for I. D. information.	—	—	(i) no (ii) no	A. N.	i) A. N. i) A. N.
Helis		Agriculture only	yes	yes $0.46 per $100.	yes	$0.31 per 100 cu. ft. to 1000 cu. ft. 0.25 per 100 cu. ft. for next 2000 c.f. 0.09 per 100 cu. ft. for all over 3000 cu. ft. (all rates per month)	—	—	(i) yes (ii) A. N.	A. N.	i) A. N i) A. N.
Madera		Agriculture only	no	yes $3.60 per $100.	yes (per acre feet only)	$250 per acre feet	—	—	(i) no (ii) no	A. N.	i) A. N.
Santa Fe		yes	yes	yes $1.86 per $100.	yes	$0.07 per 100 cu. ft.	0.27 per 100 cu. ft. to 2000 cu. ft. 0.17 per 100 cu. ft. over 2000	—	(i) N. K. (ii) N. K.	A. N.	(i) A. N. (ii) A. N.
Shafter Wasco		Agriculture only	no	yes $2.50 per $100.	yes (acre feet only)	$3.50 per ac. ft. plus $3.00 per irrigatable acre standby	—	— — —	(i) no (ii) no	A. N.	i) A. N. (i) A. N.

SUMMARY OF DISTRICTS WATER PRICING PRACTICE AND POLICY*

LOCATION		PRICING POLICY				PRICING STRUCTURE		PRICING STRUCTURE			
						RATE SCHEDULE		SERVICE CHARGE	FIRE SERVICES	TIME	OTHER INFORMATION
AGENCY	COUNTY	Is a differential pricing policy for different classes of use used?	Is a declining block rate used?	Is revenue suplimented by ad valorem taxes? If yes, what is the rate per $100 of assessed valuation?	Are meters used?	INSIDE DISTRICT	OUTSIDE DISTRICT (Excepting Private Fire Services)	Does (i) a meter service charge apply? (ii) a battery meter special charge? (If yes, see Appendix A-1-a for details.	Are these separate Fire Service Charges?	Does state price vary in (i) season (ii) future?	
Alameda County Water District	Alameda	No	Yes	Yes Not stated in reply. Based on District Act, see Appendix A-1-c tax is:	Yes	A) For the first 6,600 c.f.: $0.28 per cu. ft. For the next 60,000 c.f.: 0.24 per cu. ft. For the next 600,000 c.f.: 0.19 per cu. ft. For all over 666,600 c.f.: 0.16 per cu. ft.	For the first 6,600 cu. ft. $0.35 per 100 wft Next 60,000 cu. ft. 0.30 per 100 wft Next 600,000 cu. ft. 0.24 per 100 wft Over 666,600 cu. ft. 0.20 per 100 wft	(i) yes (ii) yes	yes	(i) no (ii) no	
Central Basin Municipal Water District	Los Angeles	Yes	No	No	Yes (per ac. ft. only)	Charges same as for M. W. D. of Southern California plus $1.00 per a. f. for domestic and agricultural uses, except ground water replenishment water is resold at M. W. D. rates. Effective Date July 1, 1965 ($ per acre feet Filtered) Untreated / Filtered / Softened and Filtered A) Replenishment Water: 16.00 / 21.00 / 25.00 B) Agricultural Water: 17.00 / 22.00 / 26.00 C) Other purposes: 29.00 / 34.00 / 38.00		(included in water fall) ($1.00 per acre feet) (i) no (ii) no	N. K.	(i) no (ii) yes (See Appendix A-1-a)	
Coachella Valley County Water District		yes	Yes, different within each improvement district and only applicable to M & I uses.	Yes Based on individual improvement district	Yes (per a. c. ft. only)	1. For Improvement Districts A) Agriculture: $30 per ac. ft. B) Irrigation: $20 per ac. ft. C) Other Uses: See Appendix A-1-a 2. Basic Rates A) Agriculture: $2.75 per ac. ft. plus $.50 per day gate charge B) Industrial and Construction Water $10.00 per ac. ft. $0.05 gate charge	A) Agriculture: $50.00 per ac. ft. B) Irrigation: $60.00 per ac. ft.	(i) yes (ii) yes		(i) A. N. (ii) A. N.	$10.00 per acre standby charge for I. D. #1. Average domestic bill is $7.50 per month. Average cost of irrigation water is $20 per acre per year (includes taxes) and for an average of 6 acre-feet use of water.
Cosa Mesa County Water District	Orange	no	yes	Not stated (Expect yes)	Yes	First 2,000 cu. ft. @ $0.22 per 100 cu. ft. Next 4,000 cu. ft. @ 0.22 per 100 cu. ft. Next 14,000 cu. ft. @ 0.18 per 100 cu. ft. Over 20,000 cu. ft. @ 0.15 per 100 cu. ft.		(i) yes (ii) A. N.	A. N.	(i) A. N. (ii) A. N.	
Devils' Den Water District		All land within this district is operated by one single entity: namely, the South Lake Farms and charges are expected to be equal to the South Lake Farms rates.									

*For a more detailed description the reader is referred to Appendix A-1-a.
(This table applies only to those replies received prior to September 27th, 19[illegible])

N. K. implies not known. A. N. implies apparently not.

1. Some Further Notes on Water Pricing Data

Note 1. Water Rates - Metropolitan Water District of Southern California*

The table below gives a summary of the various pricing established and charged to a contituent by the M.W.D., from 1941, when the first stage of the Colorado River Aqueduct was placed in service until 1964.

PRICE OF COLORADO RIVER WATER PER ACRE-FOOT

		Normal Use		Storage	
From	To	Treated	Untreated	Treated	Untreated
12.20.40	6.30.48	$15.00	$ 8.00		
7. 1.48	6.30.50	18.00	8.00		
7. 1.50	11.30.54	20.00	10.00		
12. 1.54	4.30.55	18.00	8.00		
5. 1.55	10.31.55	22.00	10.00		
11. 1.55	11.30.55	18.00	8.00		
12. 1.55	.30.56	--	--	$18.00	$ 8.00
12. 1.55	6.30.57	20.00	10.00		
7. 1.57	6.30.58	22.00	20.00		
		For Agricultural Use & Replenishment			
7. 1.58	6.30.60	25.00	15.00	22.00	12.00
7. 1.60	1. 1.61	23.00	15.00	20.00	12.00
1. 1.61	1. 1.62	25.00	17.00	20.75	12.00
1. 1.62	1. 1.63	27.00	19.00	21.50	13.50
1. 1.63	1. 1.64	29.00	21.00	22.25	14.25

The Board of Directors took no action affecting water rates during 1961-62. A report dated June 1,1962, was prepared and submitted to the Board of Directors regarding general principles of rate fixing, replenishment water and the application of the existing rates therefor. At this time, the writer was unable to obtain a copy of this report, however, it may contain some interesting and applicable opinions and seems worth following up.

Note 2. a) Local Water Costs*

Data were collected concerning costs of water in the southern California area for the purpose of comparing present water costs with expected costs of imported water. Present, (1960), water costs to urban consumers in areas sampled range from a low of $35 per acre-foot to a high of $.68 per acre-foot with the majority of water deliveries in the areas sampled having costs to the consumer of about $75 per acre-foot.

* This information was extracted from the "Report for the Fiscal Year, 1961-1962," of the M.W.D. of Southern California.

In urban areas, distribution, meters and service, customer accounting, taxes, and general administration expenses are reflected in water costs averaging between $40 to $70 per acre-foot with production, treatment, and conveyance expenses costing consumers in sampled areas which receive water from surface distribution systems vary from $6 to $108 per acre-foot, with the majority of water deliveries in the areas sampled having consumer costs of about $25 per acre-foot.

These data are shown graphically on Figures 1 and 2, which depict the frequency of the magnitude of consumers costs for water by the amount of water delivered relative to the total deliveries of all agencies sampled. Tables 5 and 6 summarize the results of this water cost survey. (These tables have been extracted and are shown on the preceding pages.)

In addition to these data on costs of water provided through surface distribution systems, a comprehensive analysis of the actual cost of pumped ground water with present day installation and energy costs was performed in the Kern County Service Area, and correlations of cost to plant use factors and pumping lift were prepared.*

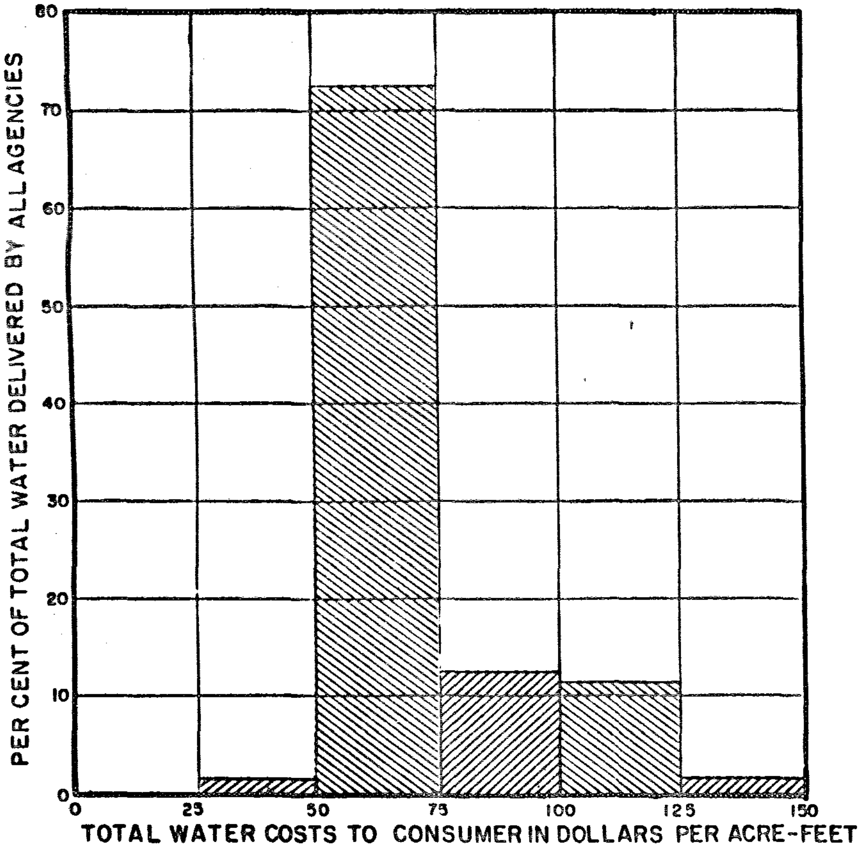
Note 2. b) Costs of Water to the Farmer

Full recognition of water pricing policies of existing water supply organizations was taken with respect to the influence of these policies on agricultural development. For example, it was assumed that the present water pricing policy of the Metropolitan Water District would prevail in the future. The annual cost of Colorado River water to the District, reflected in debt service on its outstanding bonds plus operation and maintenance costs, are recovered in large part by ad valorem taxes on all lands and improvements within the District. Anominal sale price for water, approximating operation and maintenance costs, is charged on all water sold to member agencies of the District.

From studies of factors of residual income and return on investment, it was found that in the coastal portions of San Diego, Riverside, and San Bernardino Counties, Orange and Ventura Counties, and in south coastal Santa Barbara County, residual income for the relatively high value crops projected for these areas was sufficiently large to justify the conclusion that irrigated agricultural development would not be limited by the cost of water to the farmer. In northern Santa Barbara and San Luis Obispo Counties, it was found that residual income from some of the climatically adapted crops, which could only be grown on a small proportion of the total acreage, would exceed estimated water costs by an amount which would yield adequate rates of return. However, for substantial acreages of land, residual income from adaptable crops indicated that cost of water to the farmer would be a limiting factor on the development of irrigated agriculture on these lands.

*The following is extracts from Bul.#78, State of Calif.,Dept. of Water Resources,"Investigation of Alternative Aqueduct Systems to Serve So. California". Appendix D, "Economic Demand for Imported Water".,1960

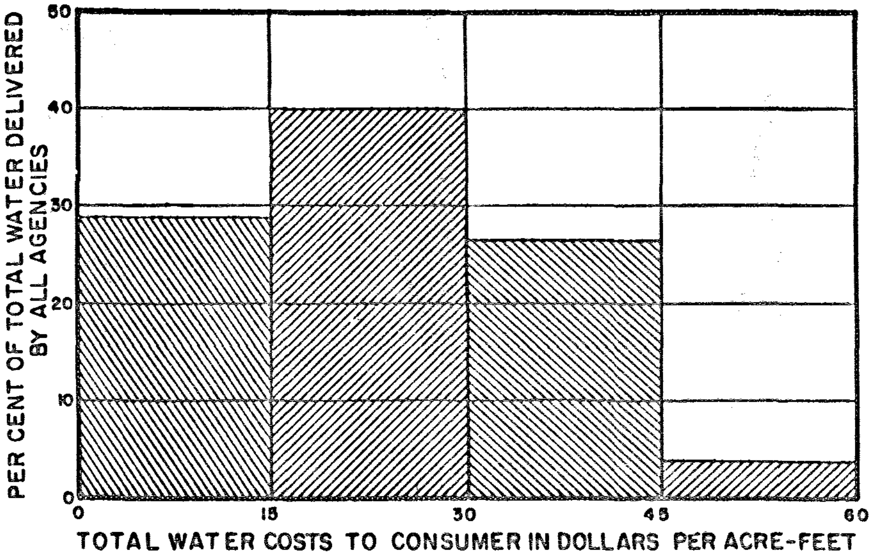
FIGURE 1



NOTE:
BASED ON A SAMPLE OF 28 AGENCIES DISTRIBUTING WATER TO URBAN CONSUMERS.

FREQUENCY OF DISTRIBUTION OF LEVELS OF WATER COSTS TO URBAN CONSUMERS

FIGURE 2



NOTE:
BASED ON A SAMPLE OF 12 AGENCIES DISTRIBUTING WATER TO AGRICULTURAL CONSUMERS.

FREQUENCY OF DISTRIBUTION OF LEVELS OF WATER COSTS TO AGRICULTURAL CONSUMERS

DEPARTMENT OF WATER RESOURCES

TABLE 5

LEVELS OF URBAN WATER COSTS AND QUANTITIES OF WATER DELIVERED BY SAMPLED WATER AGENCIES IN THE SOUTHERN CALIFORNIA AREA IN 1957

evels of water cost, dollars per acre-foot	Annual water deliveries by sampled agencies as a function of cost		Per cent of total water delivered at cost, each level	Weighted average cost, by levels of water cost, in dollars per acre-foot
	Deliveries in acre-feet	Cost in dollars per acre-foot^a		
$ 25 to 50	2,400	$ 35	1.5	$ 44
	8,000	45		
	1,000	50		
Subtotal	11,400			
51 to 75	1,000	58	72.8	66.5
	8,800	61		
	22,500	62		
	444,000	65		
	9,200	70		
	12,200	71		
	28,800	72		
	41,500	73		
	800	74		
Subtotal	568,800			
76 to 100	21,000	78	12.6	82
	10,500	79		
	3,200	80		
	4.400	80		
	9,400	80		
	700	82		
	9,800	82		
	2,700	83		
	23,900	83		
	5,400	87		
	1,000	96		
	5,700	98		
Subtotal	97,700			

TABLE 6

LEVELS OF AGRICULTURAL WATER COSTS AND QUANTITIES OF WATER DELIVERED BY SAMPLED WATER AGENCIES IN THE SOUTHERN CALIFORNIA AREA IN 1957

evels of water cost, dollars per acre-foot	Annual water deliveries by sampled agencies as a function of cost		Per cent of total water delivered at cost, each level	Weighted average cost, by levels of water cost, in dollars per acre-foot
	Deliveries in acre-feet	Cost in dollars per acre-foot[a]		
$ 0	3,600	$ 6		
to	7,400	9	29.3	$ 9.1
15	2,000	15		
Subtotal	13,000			
16	800	17		
to	12,200	22	40.2	22
30	4,900	23		
Subtotal	17,900			
31	800	31		
to	2,500	36	26.6	38.8
45	6,600	40		
	1,900	41		
Subtotal	11,800			
over	400	55	3.9	55
45	1,400	55		
Subtotal	1,800			
TOTAL	44,500		100.0	

a. These costs include all charges to the consumer including cost of water, taxes and assessments.

LEVELS OF URBAN WATER COSTS AND QUANTITIES OF WATER DELIVERED BY SAMPLED WATER AGENCIES IN THE SOUTHERN CALIFORNIA AREA IN 1957
(continued)

Levels of water cost, dollars per acre-foot	Annual water deliveries by sampled agencies as a function of cost		Per cent of total water delivered at cost, each level	Weighted average cost, by levels of water cost, in dollars per acre-foot
	Deliveries in acre-feet	Cost in dollars per acre-foot[a]		
$101				
to	8,300	$111	11.4	$118
125	80,000	119		
Subtotal	88,300			
over	8,600	130	1.8	144
125	5,000	168		
Subtotal	13,600			
TOTAL	779,800		100.0	

a. These costs include all charges to the consumer including cost of water, taxes, and assessments.

2. Discussion of Water Agency Pricing Behavior.

The pricing data presented in the preceding, 1 of Part A, may be discussed from many points of view. However, only a few aspects, which certainly have important influence on optional water pricing will be discussed here. It should be made clear that general conclusions are dangerous to draw from the limited sample of agencies selected. However, with regard to those areas investigated at least some interesting questions can be raised.

Differential Pricing by Class of Use.

Firstly all irrigation districts who supply domestic water together with agricultural water apply a differential pricing schedule. This is logical, considering the major constituent interest is generally agriculture and that federal projects (constructed usually be the U.S.B.R.) would follow a similar discriminatory pricing policy.

Again all those districts who purchase their water from the M.W.D. (Central Basin M.W.D., Ramona M.W.D., San Diego W.A., Orange County W.D., & Otay M.W.D.) also carry over the M.W.D. differential pricing scheme. This is understandable considering the large rebate given for agricultural water use and any readjustment from the wholesale rate would be financially infeasible. Those districts having a differential pricing schedule (6 excluding the irrigation districts) usually have a rate schedule based on a cost per acre foot. The three exceptions are Otay M.W.D., Ramona M.W.D., and San Diego W.A. with declining block rates (even for agriculture) and these agencies all purchase their water from the M.W.D. which has a fixed, but differential, price schedule.

Only one (Central Basin M.W.D.) of the six districts mentioned above levies no tax assessment. A differential (by class of use) rate structure was found in 6 of the 9 agencies excluding Devil's Den other than irrigation districts and was found, on the surface to be a result either wholesale supply price or agricultural interests influencing price policy of the district.

Declining Block Rate.

Where domestic water consumption appeared high a declining block rate usually existed. (San Diego W.A., Central Basin M.W.D. and Orange County M.W.D. being the inportant exceptions. These purchased their water from the M.W.D. of S.C.).

Tax Assessments.

Only 2 districts (Central Basin M.W.D. and San Gabriel W.D.) did not have tax levies. Central Basin M.W.D., however charges a surcharge of $1.00 per acre foot above M.W.D. of S.C.'s rates which it purchases.

The rate of levy varied considerably especially among the irrigation districts. Usually the tax assessment is the district's revenue source for capital costs of expansion, for bond purposes, or for other repayment obligations. The usual rate is of the order of $0.25 per $100 of assessed valuation. In some cases it was not clear if the assessed valuation was on improved or unimproved valuation and this could account for the differences. Further examination of the District's Act would clarify this point. With irrigation districts and other districts with strong agricultural interests the levy is based on the unimproved valuation. Among irrigation districts the tax rate varied considerably, obviously reflecting each districts indebtedness.

Metering.

Metering was common in districts with high domestic use and the usual meter charging pattern was followed in terms of installation rental and service charges.

Rate Schedules.

It was observed that the pricing schemes for combined domestic and agriculture use followed 2 basic patterns - either a declining block rate or a per acre foot charge. (Exceptions are Fair Oaks and Carmichael).

Both of the districts not using a price differential by use employed the declining block type of rate structure.

Only Alameda County W.D. and Coachella Valley County W.D. had schedules for outside their districts. (El Dorado also stated a 50% surcharge to all users for outside district use).

Within a type of rate structure price and policy price seemed fairly consistent with variation being reasonably attributable to marginal costs of service or increased distribution costs.

Policy Statements.

Few agencies commented on their water pricing policy. However, with regard to those districts purchasing water from M.W.D. of S.C. the rational behind the differential price aspect of their rate structure was implicitly clear. One interesting statement (Ramona M.W.D.) justifying a declining block rate, favoring heavy water consumers was "to encourage water use as the Disticts (Ramona's) system is operating below capacity, and, as a consequence, at less than peak efficiency". This is one result of over building water supply facilities and not using stage construction.

Other justifications for a differential pricing policy were based on system demands billing costs, priorities in use and pumping costs. All of these reasons except pumping costs (and perhaps, but unlikely billing costs) cannot justify the differential in price which exists between agricultural and domestic water use.

3. Three General Policy Statements

It was the intention of the writer to attempt to obtain from sources a direct inquiry of each district, a statement related to the District's pricing policy. Unfortunately only three brief statements were obtained. They are of relevance to the preceding data and discussion and are hence included below.

Alameda County Water District

This district and its area has a quite similar character in many ways to Santa Clara. Included in the district are about 15,000 acres of irrigated lands and a present population of approximately 60,000. The district is experiencing a rapid population and industrial growth.

One of the district's major functions is the management of valuable ground water supplies in the Niles Cone, which underlies the district.*

The districts other major function is the distribution of municipal water supplies to about 50,000 people and numerous industries within the district. Essentially all of the water used for irrigation, and a large part of the waters used for industry are obtained from individually owned wells.

The District approves of repayment of all costs incurred by the State in the furnishing of irrigation water should be fully paid for by the users, thus allowing the acreage limitation to the eliminated.

The District holds that all power developed by State water projects should be sold at rates that maximize total revenue.

South Bay Aqueduct water and supplimented local supplies are used for ground water recharge.

The district's source of funds from water (in pricing schedules) include water revenues from the district's municipal distribution system, ad valorum taxes and an assessment on the basis of water pumped from individually owned wells. No definite policy statement on the level of each to be employed in District's water pricing schedule can be made by the present writer.

* Based on extract from Interim Assembly Committee Report, Vol. 26, No. 1.

Coachella Valley County Water District.

It is the stated policy *of the district that those who use the water shall pay all operation and maintenance costs and return to the State the aggregate of all reimbursable capital costs with interest. Acreage limitation is not favored.

A uniform supply price to the agency from the state is supported where the water contract price would be based on proportional use of the main supply system. The need for a price differential is stated as being a matter to be determined when the local contracting agency.

Irrigation Districts in California.

A general note on irrigation districts and their policy is given below.*

*Irrigation districts today include over half of the irrigated land in the State. Irrigation districts, assess (tax) only the unimproved land value of all land in the district, whether it is irrigated or not. In irrigation districts as in county water districts all registered voters are eligible to vote.

The tax on improvements in county water districts reflects the use of that act more frequently where there is substantial domestic service and where improvements, such as homes and industries are more the beneficiaries of the water supply than the fixed land itself. Also this type of tax raises substantially more revenue.

The I.D.A. of California has consistently opposed the application of federal acreage limitation concept.

As noted earlier selective sample of six irrigation districts was chosen to allow a brief and specific study of current irrigation district water pricing practice. The irrigation districts were mainly chosen on the basis of having a reasonable level of domestic and industrial water service as well as agricultural water supply.

This was done by determining the ratio of urban (in town) population to total district population in the district. Subjective judgement was also used in this choice.

A few irrigation districts were chosen with what appeared to be very low "in town" population to provide contrast with the more "urbanized" irrigation district.

*Policy Statement extracted from Assembly Committee Report,Vol.26, No. 1 Feb., 1960.

*Extracts from Assembly Interim Committee Report on Water Problems, Vol. 26, No. 1, Feb., 1960

SECTION 3 - Part B: State and Federal Pricing Policy

This part B, of Section 2, briefly outlines the water pricing practices and policies of the following government agencies:

1. State of California Department of Water Resources
2. U. S. Bureau of Reclamation
3. U. S. Corps of Engineers
4. U. S. Soil Conservation Service.

The water pricing policies of these higher level government agencies have been outlined to provide a different, broader, and perhaps instructive viewpoint for policy evaluation.

It will be noticed from the following notes that each water agency, be it local, state or federal, has a water pricing policy that reflects quite clearly its objectives and aims in water resource development and utilization.

State Department of Water Resources Pricing Policy

The following notes are extracts from Chapter IV, Assembly Interim Reports, Vol. 26, No. 1, "Economic and Financial Policies for State Water Projects", February, 1960.

PRICING AND REPAYMENT OF VENDIBLE SERVICES

Revenues from each bendible project purpose should fully repay the allocated costs of providing that purpose and full repayment can best be achieved by market pricing, to the extent it can be applied to a water project and that it is the only rational and economically sound pricing basis in our economic order.

Pricing Basis

Market pricing of water or power are not true examples of market pricing because limitations on price are established by the State in the public interest. In the pricing of water to irrigation, industry, and domestic users, the State and the purchaser are the only two entities in a given transaction and they determine the market price which is not expected to be higher than the costs.

The value of project water to each purchaser will vary and the State's price, which only covers costs, will not fully reflect these variations in vlaue. Different cropping patterns, managerial efficiencies, distribution costs, sizes of operation and other factors will cause the value of the water to vary among purchasers. Local distributing agencies have the perogative to price water to the ultimate purchaser upon a combination of tolls and aseessments which can partially equalize the payment for water according to the value of water to the different purchasers. Full repayment will require the distributing agency to secure a fair share of costs from all properties and persons who receive any substantial value from the water supply.

In furnishing water to farm and other lands, excessive benefit can occur if there is a) subsidy, b) land enhancement attributable to subsidy of c) land enhancement without subsidy. There should be no subsidy to irrigation water users or other purchasers of bendible services.

A full-repayment policy with no subsidy is the most economically sound and easily administered restraint upon excessive land enhancement that the State can adopt in its water pricing.

The state charge a one-rate, zoned price for water consisting of, a) a capacity charge to repay principal and interest on the aqueduct capacity designated for the purchaser, b) a demand charge to cover the operation, maintenance and replacement costs of the actual quantity of water delivered at any time to the purchaser, and c) a Delta Pool charge representing the cost of furnishing water at the Delta. The demand charge and the repayment to the Delta Pool would contain escalation clauses to permit revision of charges.

The net effect of using a one-rate, zoned price for water is to eliminate the need for the State to differentiate in either its pricing or water deliveries between water intended for agriculture, industry or domestic use. The state sells at wholesale and the local distributing agencies would make whatever differentiation with respect to ultimate use would best serve the local conditions. This principle is very important to irrigation water users because applying water to farmlands is generally reflected in a substantial increase in commerce and trade throughout the irrigated area and in the adjacent communities.

In the Southern California area, the major water agencies are already operating under relatively flat rates for water, irrespective of use, with any resulting revenue deficiency being made up by property assessments.

A conservancy district coupled with a one-rate, zoned price system in which the State charged one price for water at each zone along the aqueduct is used. A zone is defined as an aqueduct section along which the pumping, operation and construction costs are substantially the same. The one-rate, zoned price removes from the State's purview not only consideration of pricing to the ultimate consumer of the water, but also the related questions of subsidy, quantity discounts, premiums, or the equalization of values by combinations of water tolls and assessments. It should be noted that a one-rate, zoned price does not solve these problems, but leaves them to the local public distribution agency which is closer to the ultimate water user and local business interests. These local people know best the advantages of bringing water to the area and how much it is worth to both the farmer and the local business community. Under a one-rate, zoned price it would be possible for the local agencies to equalize the value of the water to various users by combinations of assessments and water tolls which consider both the type of use and the profitableness of its use.

Bureau of Reclamation Repayment and Pricing Policies

Federal programs and policies primarily serve national purposes and objectives so that what is appropriate as a federal policy. There are several overall reasons why federal reclamation policies were not found to be appropriate for California.

First, federal reclamation policy has evolved from a long series of controversial policy changes with roots going back 50 years. Its original concept was merely the investment of interest-free money received from the disposition of public lands to build projects for the improvement of public lands. Later, the Bureau of Reclamation began using power and municipal and industrial water revenues to repay irrigation costs and also received federal tax moneys to finance construction which benefited public lands to project construction which primarily benefited private lands.

It may be surmised that any similar state program which provides highly subsidized water may lead to extensive unearned benefits and will be exceedingly controversial because of public interest will tend to limit and condition the receipt of the extensive benefits provided.

Second, it makes a difference to California's economy and the policies and the State should adopt whether the state of federal government constructs a project.

Third, the use of bonds in California to finance projects requires the State to find some method to pay the interest on these bonds if irrigation water users do not. Interest is foregone on irrigation costs of federal projects.

Fourth, the future economic growth of California will depend primarily on industrial expansion rather than agricultural growth.

Fifth, the problems of limiting subsidy is granted.

Repayment capacity or ability to pay tends to be a ceiling on water pricing and not a floor which can assure prices that will recover all or even a designated portion of costs. Ability to pay is a satisfactory measure of the market during project planning but it is not a basis for pricing.

*These notes are extracts from chapter IV, Assembly Interim Reports, Vol. 26, No. 1. "Economic and Financial Policies for State Water Projects". February, 1960.

The following is a direct, but abridged, extract from Reclamation Instructions, Series 110 Project Planning, Part 116 Economic Investigations, Chapter 6 Repayment of Project Costs and is included to outline Bureau of Reclamation Water Pricing Policy.

INTRODUCTION

Objective. Project costs associated with the purpose of irrigation are reimbursable without interest; those associated with the purposes of power and municipal and industrial water supply are reimbursable with interest; and those associated with the purposes of flood control, navigation, and fish and wildlife are nonreimbursable. Economic feasibility is demonstrated when revenues which are anticipated to accrue as a result of the project and which would be available for payment of reimbursable costs are sufficient to meet those costs within a reasonable period.

IRRIGATION REPAYMENT

Basic Policy. Basic Reclamation law provides for development and maintenance of a stable and prosperous family farm economy and for repayment without interest, within a 40-year period or a 50-year period, of project costs property allocable to irrigation. The payment capacity of irrigators is that portion of increased net farm income available to meet water charges after allowances have been made for returns to farm investment and to family labor and management or family living. Water charges include a component for project investment and a component for project operation, maintenance, and replacement costs.

Determination of Payment Capacity. Payment capacity shall be determined by comparative analysis of farm budgets for family-type farms considered to be representative of future conditions with the project in operation, and for farms considered representative of future conditions without the project. The difference in net farm income between the two conditions should be analyzed in terms of allowances for return to family labor and management, or family living, and for return to farm capital, in order to determine the residual available to meet water charges. Thus, payment capacity is the maximum annual amount that water users will be able to pay for irrigation service out of farm requirement, the project should not be recommended for authorization or construction. Premature commitments on repayment and related matters must be avoided, however, because the Commissioner's approval of a Definite Plan Report is required prior to execution of repayment contracts.

Repayment Contracts.

A. Contracts Under Reclamation Project Act of 1939. The traditional contract based on Section 9(d) of the Act of 1939, provides for payment of annual operation, maintenance and replacement costs and for repayment of the construction obligation over a period of not more than 40 years after a development period not exceeding 10 years.

B. Loan Programs. Public Law 130 (July 4, 1955, 69 Stat. 244, as amended May 14, 1956, 70 Stat. 155) permits interest-free loans to irrigation districts or other public agencies for construction of distribution systems authorized under Federal Reclamation law. Public Law 984 (August 6, 1956, 70 Stat. 1044, as amended June 5, 1957, 71 Stat. 48) provides for loans and grants for projects with an estimated cost of not to exceed $5,000,000.

Costs allocated equitable to reimbursable purposes are repayable in not more than 50 years, with interest on domestic, industrial, or municipal water supply, commercial power, and irrigation benefits to lands held in private ownership in excess of 160 irrigatable acres by any one owner. Other project costs assigned to irrigation are repayable without interest.

REPAYMENT OF POWER INVESTMENT

Levels of Rates for Sale of Power. Power and energy will be sold at the lowest possible rates to consumers consistent with sound business principles. Rate schedules will be established on a basis which will recover the cost of producing and transmitting the energy and will return the investment in generation and transmission facilities together with interest in not more than 50 years. If irrigation costs are assigned to power for repayment, power rates shall be such as to pay out these additional costs within a reasonable time.

Level of Rates for Irrigation Pumping. Preferential power rates for irrigation pumping on Federal Reclamation projects shall be given full recognition in establishing power rates and estimating power revenues. Uniform rates for pumping power shall be established over as wide an area as practicable. Generally, such rates on Federal Reclamation projects shall cover the average cost per kilowatt-hour of operation, maintenance and replacement expenses of the power system, and, without interest, the payment of that part of the power investment allocated to irrigation.

Assistance Required for Irrigation. Assistance required from power revenues to assure full repayment of irrigation costs may require an increase in the firm energy rates. Ordinarily, the total project payout period will provide for a period of time, after the power investment is fully liquidated, for application of full net annual power revenues to assist in repayment of irrigation costs.

As irrigation costs are repayable following a maximum development period of 10 years, and as power costs are repayable within 50 years with no development period, some leeway in time may be available.

MUNICIPAL AND INDUSTRIAL WATER REPAYMENT

Basic Policy. Reclamation law and policy provide for the furnishing of raw water from Federally constructed supply facilities for municipal, industrial and miscellaneous uses. Municipal and industrial water supply investments, including both construction costs and an appropriate share of interest during construction, shall be returned in full with interest within 50 years after the supply features are completed and placed in service.

Contracts Under Act of 1939. Two types of contracts for the repayment of investment costs are applicable under Section 9(c) of the Reclamation Project Act of 1939:

(1) Repayment Contracts. Contracts that require repayment of allocated costs over a period of not to exceed 40 years from the year in which water is first delivered, with interest not exceeding the rate of 3.5 per cent if the

Secretary determines an interest charge to be proper, and,

(2) Water Service Contracts. Contracts for such periods, not to exceed 40 years, and at such rates as will produce revenues at least sufficient to cover an approporate share of the annual operation and maintenance costs and such fixed charges as the Secretary deems proper. Subsequent contracts will be necessary to cover the repayment period of 50 years for municipal and industrial water.

Basis for Rates and Charges. Payments for municipal and industrial water shall be established so as to affect project payout of allocated costs in a period of not to exceed 50 years. The rates or annual base payments shall be at levels sufficient at least to meet allocated annual operation, maintenance and replacement expenses regardless of the amounts of water furnished. The rates, also, shall not be higher than those necessary to cover costs of the most likely single-purpose alternative water supply in the absence of the project.

Net Revenues. Net annual revenues are gross annual revenues minus annual operation, maintenance and replacement expenses.

Net revenues shall be sufficient to amortize the municipal and industrial water supply investment with interest within 50 years. When municipal and industrial water revenues exceed repayment requirements, or when they are available after the investment is retired, the surplus revenues may be applied to assist in the payment of irrigation costs.

Before leaving these statements on the Bureau of Reclamation's repayments and pricing policy, a note on Agriculture Subsidy is thought important.

Besides encouraging inefficient development of water based agriculture in areas where the costs of delivering water is expensive, most farm subsidies are questionable value to real farm income. Over a period of time as farm land is bought and sold, the farmers who own or rent the land will not be the people who derive the benefits from low cost water; they will have paid a price for their land which included the capitalized value of the water subsidy, and they will then be dependent on continuing water subsidy in order to improve.

Again by establishing a price for agricultural users, based on marginal water supply cost, farmers would cease to be dependent on Federal subsidy and efficient and unwasteful water allocation would be approached.

*S. R. I. report, Economic Consideration in the Formulation and Repayment of California Water Plan Projects, 1958.

Corps of Engineers Pricing Policy Statement

Extract from Corps of Engineers Manual - Water Supply Shortage in Corps of Engineers Projects

APPENDIX IV

Water Supply Act of 1958, Title 111, Public Law 85-500
as Amended by Public Law 87-88. (43 USC 390b)

Storage may be included in any reservoir project constructed by the Corps of Engineers to impound water for present or anticipated future demand or need for municipal or industrial water, provided, that the cost of any construction or modification authorized under provisions of this section shall be determined on the basis that all authorized purposes served by the project shall share equitable in the benefits of multiple-purpose construction, as determined by the Secretary of the Army.

That the City recognize the responsibility of repayment to the United States of all costs allocated to the requested water supply storage.

Repayment.

a. All construction, operation and maintenance, replacement, and interest costs incurred by the Federal Government and allocated to water supply should be repaid by the water users except for part of such costs allocated to future water.

Interest Rate.

The interest rate to be used to determine repayment requirements in computing interest during construction on the construction costs allocated to water supply and interest on the unpaid balance will be determined by the Secretary of the Treasury pursuant to the Water supply Act of 1958 and will be furnished by the Chief of Engineers.

Responsibility for maintenance and operation of water conveyance facilities generally will be assigned to local interests.

Soil Conservation Pricing and Repayment Policy Statement

Extract from the Planning Manual of - Water Protection Handbook of UNITED STATES DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

The plan can include only those works of improvement producing direct measurable benefits in (1) flood prevention, or (2) the conservation, development, utilization, and disposal of water.

No single plan can be submitted for a watershed or subwatershed area exceeding 250,000 acres.

No structure providing more than 5,000 acre-feet of floodwater detention capacity or more than 25,000 acre-feet of total capacity may be included in the plan.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

This note deals with evaluation of facilities for provision of a municipal or industrial water supply as a part of a small watershed project.

RESPONSIBILITIES IN EVALUATION

When a project includes provision for a municipal or industrial water supply, it is necessary that the sponsors furnish an estimate of the benefits to be expected.

Soil Conservation Service

The Soil Conservation Service does not estimate the benefits to be obtained from inclusion of a water supply for municipal or industrial use as a project purpose.

It is thought necessary before concluding this section, to include a further note on the water pricing practices of Federal and State Government Agencies. This section is therefore, devoted to an examination of these repayment aspects.

The federal government does not undertake to supply water for municipal and industrial use as such, and the provision by the federal government of irrigation water is incidental to the objectives of land reclamation and/or flood control. Thus, federal precedents may not be suitable for adoption by the State or local agencies.

The Distinction Between Water for Irrigation Use and for Municipal and Industrial Use. The federal government has regarded the provision of irrigation water as a project purpose separate and apart from the provision of water for municipal and industrial purposes, costs have been established separately. The subsidization of irrigation water has tended further to segregate the market for project water into these two distinct parts, and this distinction has carried over into the private economy as well. Many private water companies, for example, offer lower rates and charges for irrigation water than for municipal and industrial water, either directly in their schedules or through price differentials based on quantities of water delivered. If these precedents are followed, irrigation water and municipal and industrial water, to be supplied by State projects and local agencies, may also be regarded as serving different markets.

*Taken from "Economic Considerations in the Formulation and Repayment of California Water Plan Projects", Stanford Research Institute Report. March, 1958.

The "ability to pay" determination is in effect negotiated by the federal government with the beneficiary groups. "Ability to Pay" is in reality an expression of the amount that the beneficiary believes he ought to be required to pay in view of established policies of subsidization and cost sharing. Usually, it is an amount that he is willing to pay in view of the amounts that other users served by other projects are paying. Thus, the repayment determination is an arbitrary one, largely unrelated to allocated costs.

The adoption of these practices by other agencies would hardly seem appropriate or reasonable. e.g. The interest of the State of California supplying irrigation water would seem to be no different from that in supplying municipal and industrial water. Moreover, if a project has been formulated properly on the basis of estimates of economic demand, beneficiaries can be expects to have the ability to repay all costs (including interest) allocated to the irrigation water supply purpose.

Because of a difference in basic objectives, it is likely that any State or local pricing policy with respect to irrigation water will result in payment terms less attractive to irrigators than those of the Bureau of Reclamation.

Municipal and Industrial Water

The objectives of the State are that the repayment policy for municipal and industrial water be the same as for irrigation water (i.e., full repayment of allocated costs by the beneficiaries).

Certainly, if benefits are measured separately and costs are allocated separately using benefit values as determinants, different repayment requirements will result. Since, moreover, the benefit value per unit of municipal and industrial water is likely to be greater than that of irrigation water, the price per unit of municipal and industrial water is likely to be greater than that of irrigation water. If any repayment schedule based on allocated costs, then, the repayment responsibility of irrigation water users will be less on a per-unit basis than will the repayment responsibility of municipal and industrial water users. This difference is attributable to the causes mentioned rather than to any state policy of deliberate subsidization of irrigation water users as such. This feature also carries over to local agencies.

Also, if repayment requirements reflect the relative costs of transporting water to the various beneficiary groups, this differential in repayment responsibilities will likely be accentuated. Most of the water visions of the California Water Plan is transported a shorter distance than most of the water that will be made available for municipal and industrial use.

Irrigation Water.

In federal practice, interest is waived on costs allocated to the irrigation water supply purpose. This waiver amounts to a hidden subsidy which, over the lifetime of a typical project, reduces by about one-half the irrigation water user's repayment responsibility. Costs allocated to irrigation are further limited to an amount separately determined to be within the user's "ability to pay". Remaining costs are then reassigned for repayment from surplus power revenues, from revenues remaining from the sale of municipal and industrial water after the costs of that purpose have been amortized, and in certain instances, from a portion of power revenues equivalent to the interest repayment on costs allocated to the power purpose.

SECTION 4: Note 1: Water Pricing and Suggested Pricing Rationales within Retail Agencies in Northern California: A self contained note.

The following note is based extremely heavily on a preliminary draft of Chapter 17, of "The Northern California Water Industry", by Joe S. Bain, Richard Caves and Julius Margolis, to be published in 1966. The moniter of this report wishes to make it clear that for the following information, he is greatly indebted to the above, yet uncompleted manuscript.

Pricing and Water Allocation within Retail Agencies

This note is a review of the conduct of water agencies in determining the prices charged by agencies for water distributed to their customers. We shall be dealing with short-run situations in which the water supply of the agency is not altered by building a new dam or enlarging canal. The agency must choose some means of allotting available water among its customers and, in the process, cover its own costs of operation. Economists normally think of the adjustment of prices as the main method of performing this matching of demand to supply. In fact, various rationing tools besides price adjustments receive considerable use in the water industry, and those are also reviewed below.

A. Setting and Significance of Retail Water Pricing

The bulk of Northern California agencies supplying water to final users takes the form of public districts, either special districts or general units of local government. The economic behavior of these units might best be viewed as that of cooperative organizations serving the economic interests of their regular customers. This analogy provides both a framework for making a normative appraisal of the performance of these units and a source of detailed hypothesis about their conduct.

The decision on pricing water to member-customers should obviously provide a major test of the effects of the organizational traits of public water agencies on their operation. The pricing decision affects all customers and raises all possible issues of equity as between them. In the debates of agency managements, issues of equity in fact dominate the setting of prices. The political nature of a public body necessitates a broad community support for its operations. A price structure which arouses a sense of exploitation may create insurmountable barriers to political consensus and frustrate other plans.

Agricultural water agencies, being largely single-purpose organizations, normally prove directly responsive to the wishes of their electorates in setting prices, as in other matters. The chief interest of irrigators, in the short run, lies in minimizing the supply price of water; the chief legal restriction on the district's charges to them is that revenues cover all current financial obligations. Putting these organizational features together, the dominant objective of short-run pricing by agricultural water districts is predicted, and turns out to be setting charges to cover current money costs. Many other objectives, however, can also affect agricultural water prices, and the relatively complex structure of these charges provides a vehicle for reflecting them within the general framework of covering costs.

Urban water service is often provided by a department of a general municipal government, although special districts and private water companies retain a significant role. In contrast to agricultural district, however, the pricing of water is less important both to most customers and as an element in the range of decisions made by local city governments. Water prices are usually set primarily to cover costs, as in agricultural agencies, and the structure of charges is used to promote other objectives, especially where wholesale charges to other governmental units occur.

In Section 2, some of the basic normative rules for the allocation of water between independent, competing uses were outlined. For instance, water districts diverting the water of a particular river should divide it among themselves in such a way that the marginal value of water taken, net of transport and distribution costs, should be the same for all districts. This common marginal value becomes the net opportunity cost of water to each agency. Within a district essentially the same principle operates. Let us suppose, first, that the long-run marginal costs per acre-foot of the district's operations are the same for service to any member customer. Then the price charged by the district to customers should equal the sum of the opportunity cost of water to the district plus its own long-run marginal costs of operation, with each user permitted to take a quantity of water which equates this retail price to the net value of marginal product of water in his own operation. Such a retail pricing pattern in all districts, combined with a correct opportunity cost, would be consistent with optimal allocation of water throughout the river basin in question. In the resulting revenue fails to cover total costs for the district, a charge independent of the quantity of water taken should be levied upon users to make up the difference.

Typically, a water agency does not incur the same long-run marginal costs to serve all customers at all times, so that a single price to all members will not suffice. Customers will be located at varying distances from the agency's wholesale source of water or diversion point, and the greater length of canals or mains required to serve the more distant users are reflected in higher long-run marginal costs of serving them, and a higher appropriate unit charge. Some residences or farmlands may lie at higher altitudes than others, so that greater water costs are needed to sustain a given water pressure or delivery rate. Where the groundwater basin underlying an agency's lands serves as a natural storge basin, replenished by the agency's operations and drawn upon by the pumps of its members, prices must be adjusted to insure efficient conjunctive use of the groundwater basin.

These factors influencing the appropriate retail pricing pattern direct our attention to many features of the tolls, assessments, block rates, and the like, used in pricing California water. They also point to the importance of water rationing devices, where and when they supplement the use of tolls in allocating water among alternative final users. A pricing system that is optimal without rationing cannot be optimal if rationing is introduced with other factors constant. Water rationing is normally used only as an emergency measure in urban water distribution, but plays an important part in some agricultural agencies. In abstract theory, optimal pricing and investment decisions can be made by setting prices equal to short-run marginal costs and expanding the fixed plant whenever short-run marginal costs (and price) exceed long-run marginal costs. One can indeed conceive of correct investment decisions being made even if inappropriate pricing rules are in force when the investment decision is made, assuming that the inefficient pricing is due to some cause other than lack of information. In fact, the evidence s suggest that decisions of water districts to expand their storage and distribution capacity often rest (within the limits of financial feasibility) upon relatively simple tests of the "adequacy" of the existing water supply. In this case, links between the efficiency of short-run pricing and the efficiency of investment become extremely important. If excess demand for water appears because of pricing below short-run marginal costs, not only will current water use be too great (in the absence of rationing) but also in the inducement to invest may look stronger than it should.

The following sections deal first with the typical structural traits of retail water pricing systems and then turn more formally to the objectives which apparently underlie these characteristics, and to the normative implications of pricing. Agricultural and urban agencies by and large are treated separately, since the differences between urban and agricultural pricing are greater than their similarities. Whereas most agricultural districts charge a constant price for water, urban price schedules almost always contain a "taper" or declining marginal rate. Though most agricultural districts levy a tax on land to supplement their tolls, most urban water systems do not rely on taxes. Agricultural districts seek to use associated activities such as power as a means to reduce the price of water, while urban systems sometimes divert their water revenues to cover part of the costs of other public services. In many agricultural districts districts the irrigator usually has access to supplies alternative to the district, such as pumping from the ground-water basin, or occasionally, diverting from a river. This choice is not open to the urban consumer except for large industrial firms.

B. Patterns of Water Pricing

The major division of charges is between those which vary with the quantity of water purchased and those which are independent of quantity. The latter charges may take the form of texes, and therefore be levied on both water users and nonusers. They may consist of a charge for a meter connection, minimum delivery charge, or a fixed toll per crop-acre. Quantity charges may be based on a metering of the volume of water delivered, or some cheaper method may be used to relate the charge to the quantity taken.

Water tolls and quantity charges

Most agricultural water districts employ a charge containing two components, a water toll proportional to the amount of water sold and a tax levy proportional to the assessed value of the property within the district. The water toll is based on the number of units delivered, or sometimes approximated by the number of irrigations or the number of acres of a given crop irrigated. The acre-foot is the most water measuring unit for irrigation service; however, some districts retain charges based on a measurement of the rate at which water flows during the season rather than the volume of it delivered. (The common measurements of flow are the miner's inch) Domestic water service is normally charged in units such as thousands of gallons per day.

A number of districts approximate a water toll by a charge per irrigation under a rotational delivery system or a charge based on the number of acres of each crop a farmer raises. Such substitutes for prices per unit of water are used because they avoid the need for measuring water delivered.

When one divides the charges per acre set by the approximate number of acre-feet applied per crop, the charge per unit of water frequently turns out to vary significantly from crop to crop. For instance, in 1960, the Glenn-Colusa Irrigation District's charges, including an assessment, work out to be about $1.20 an acre-foot for general crops, $1.10 for rice, and $0.86 for clover. Sometimes the variation from crop to crop seems to be random; at other times, as we shall see, the district has a conscious policy of favoring or discouraging particular crops. The districts which cast their water tools in the form of charges per crop-acre are not randomly distributed over the state. They concentrate in areas where water is relatively abundant and cheap, principally the Sacramento River valley. It may be noted that measuring water consumption becomes inefficient when the cost of the water itself is very low, at least from the viewpoint of the district seeking to set charges in relation to its costs.

Although a number of cities in the Central Valley, such as Fresno, employ a fixed charge and do not meter water consumption, some kind of two-part tariff is the most common arrangement in urban water pricing. This usually consists of a fixed "meter charge" (sometimes including a minimum quantity of water monthly) and a toll which usually declines significantly as the user's monthly consumption increases. Tables 3 and 4 show the structure of these charges for a sample of cities in the San Francisco Bay area. Table 3 shows the meter charge and the toll pertaining to the first

Table 3
Residential Water Charges and Their Components, Selected San Francisco Bay Area Cities, 1960

	Minimum charges 5/8" or 3/4" meters	Total cost of water per month on 5/8" meter		Mimimum charges 2" meter	Toll for fst. 100 c.f. over min. delivery	Toll per 100 c.f. lgst. delivery
		1,000 c.f.	50,000 c.f.			
	(1)	(2)	(3)	(4)	(5)	(6)
Antioch	$1.75	$2.35	$ 77.85	$ 1.75	$ .20	$ .15
Burlingame	1.50	3.00	123.00	6.00	.30	.23
Daly City	0.00	3.70	113.95	0.00	.295	.225
East Bay Municipal Utility District	1.60	3.00	81.64	15.86	.20	.09
Fairfield	3.00	3.20	52.20	5.00	.10	.10
Hayward	.50	4.00	109.42	3.50	.35	.18
Hillsborough	2.00	5.20	147.00	5.00	.32	.23
Napa	1.50	3.07	42.50	3.50	.262	.133
Palo Alto	1.35	2.70	111.10	5.10	.27	.20
Pittsburg	2.65	3.33	96.78	7.00	.225	.19
Redwood City	1.80	3.30	131.08	9.00	.33	.22
San Bruno a)	1.25	2.00	75.50	1.25	.15	.15
San Francisco	.70	3.29	107.35	4.85	.259	.135
Santa Clara	1.35	2.20	68.60	5.25	.22	.13
Sunnyvale	2.00	3.35	95.56	7.50	.335	.18
Vallejo	1.50	3.00	108.05	1.50	.30	.177

a. For delivery from the city's wells. Higher tolls pertain to water purchased from the San Francisco Water Department.

Source: City of Redding, A Survey of Water Rates and Related Data for 86 Municipal Systems in Calif. as of Jan. 1, 1960 (Redding, 1960).

Table 4
Relation of Unit Water Costs for Large and Small Consumers, selected San Francisco Bay Area Cities, 1960.

	Costs per month for 1,000 c.f. 5/8" meter (per 100 c.f.)	Costs per month for 50,000 cu.f. 2" meter (per 100 cu. ft.)	Col. (2) ÷ col. (1)
	(1)	(2)	(3)
Antioch	$ .235	$ .1557	$ .66
Burlingame	.300	.237	.79
Daly City	.37	.2279	.62
East Bay Municipal Utility District	.30	.1931	.64
Fairfield	.32	.1044	.33
Hayward	.40	.224	.56
Hillsborough	.52	.30	.58
Napa	.307	.186	.61
Palo Alto	.27	.222	.82
Pittsburg	.333	.1926	.58
Redwood City	.33	.2696	.81
San Bruno	.20	.151	.76
San Francisco	.329	.223	.68
Santa Clara	.22	.137	.62
Sunnyvale	.335	.2021	.60
Vallejo	.30	.2161	.72

Source: City of Redding, A Survey of Water Rates and Related Data for 86 Municipal Systems in California as of Jan. 1, 1960 (Redding, 1960) and to the largest blocks of water purchased, along with total costs to the consumer of 1,000 and 50,000 cubic feet per month. Table 4 shows columns (2) and (3) of Table 3 into average costs per hundred cubic feet, to facilitate comparison of the charges to large and small consumers.

The tables show declining marginal water tolls for all but two cities and declining average unit costs to the customer for all. As column (3) of Table 3 shows, the rate of taper is far from uniform. Although cities do not in general set different schedules for different types of users, the quality discounts are primarily for the benefit of selected industrial users. Special rates are typically established for standby capacity to fight fires (sprinklers in buildings or fire hydrants) or for special customers, including public users (schools, parks, and the like) and spcial industries such as shipping.

Tax levies

Tax levies, the other major component of water charges, are somewhat restricted by state laws setting the powers of various types of districts. Irrigation districts can levy annual ad valorem taxes on land exclusive of improvements sufficient for certain fixed obligations and other special purposes. There is a statutory maximum on the rate of taxation for operation and maintenance and for other general purposes. Taxes can be levied according to benefits where payments must be made to the United States or where improvement districts operate within irrigation districts.

These provisions leave a good deal of flexibility to the districts. Hence they can select any mixture of charges they wish.

Assessment patterns vary a good deal from district to district. At the Fresno Irrigation District (surrounding the city of Fresno), which draws its entire water revenue from taxes on unimproved land, district land that receives surface water supplies is generally assessed at a flat $100 an acre, but the assessment is only $75 on land to which surface water must be pumped by the irrigator. The asseesment is $40 on land that receives no surface water; and $18 on land that holds riparian rights to the adjacent Kings River. Some irrigation districts have recently adopted land valuations directly relating to soil productivity by using information provided ay the Bureau of Reclamation, so that the tax component of water charges contains a relatively precise value-of service element.

Assessment practices of urban agencies are quite different. The East Bay Municipal Utility District (Oakland and nearby cities) levies a tax on all land and improvements in its jurisdiction, accepting the county assessor's estimation of the value of property. County water districts and conservation districts are the other major water agencies levying taxes in the urbanized San Francisco Bay area. The county water districts employ all property in their area as a tax base and similarly accept county assessor's appraisals. Conservation districts must usualy restrict their assessments to land only. The benefits which they confer, frequently controlled ground-water recharge, are widely dispersed, and many residents may gain only slight benefits. Restricting the tax base to land only then becomes a political necessity. Unlike irrigation districts, conservation districts such as the Santa Clara Valley Water Conservation District accept the county assessor's appraisal of unimproved land as the base for their taxes.

Many agricultural districts, like urban water agencies, use pricing patterns more complex than a combination of straight tolls and levies. Normally, these patterns have grown from some special problem of adjusting the incentives facing water users or securing equitable treatment of different groups within a district. Some districts, such as Exeter Irrigaton District add another basic component to their rate in the form of a demand charge for each connection to the irrigator's fields.

Joint use of taxes and tolls

The mixture of tolls and taxes chosen by districts often depends strongly on local history, but a few generalizations can be made. Irrigation districts in relatively prosperous areas, or districts that are themselves wealthy through sales of hydroelectric power generated at their storage dams, often use a moderate tax levy but no toll on water (e.g. Modesto and Turlock Irrigation Districts) Modesto imposes no water charges of any kind; Turlock has no toll but maintains a small tax levy of $1.10 per $100 assessed valuation) The old districts clustering around the Kings River also use only taxes and no tolls. Local spokesmen state that this is a traditional preference in the region, but it also makes good economic sense. Because of the age of their simple distribution systems these districts have no bonded indebtedness, and because of their appropriative rights to Kings River water diverted upstream from point of use, no heavy unit costs for pumping or storage. Thus their costs are both low and relatively independent of the amount of water distributed, so that revenues can be adjusted to costs more easily through the use of a tax than of a toll.

A different pattern appears in some of the districts of the eastern Sacramento River valley. Many Sacramento valley districts went through painful bankruptcies in the 1930's. Assessments are still feared as a "lien on the land," and several districts therefore avoid them entirely. Of the dozen districts on the east side of the Sacramento valley, three collect no taxes at all. Another, Richvale Irrigation District, imposes a temporary tax for a year at a time whenever its water toll revenues fall short of covering special financial requiarements. At least two districts, Camp Far West and Deer Creek, charge no toll at all and derive their revenues entirely from taxes.

Many more districts use some comaination of tolls and taxes than depend on either alone. Where the toll-tax balance does not seem to be arbitrary, a good many things can determine the actual pattern chosen. Some districts seem to set their levies at a rate which will just meet scheduled payments on their bonded indebtedness. Thus the Panoche Water District, on the west side of the San Joaquin valley, calculates its $5.60 tax rate per-acre to cover the interest and principal on its bonds. The toll is left to cover the cost of water brought from the Bureau of Reclamation plus the district's variable operating costs. Other districts buying water from a wholesaling agency often set the toll to cover the wholesale price and load the other variable costs and all fixed costs onto the tax. Generally speaking, a relatively large number of districts set tolls and levies in such a way that the toll approximates the average variable or marginal cost of water to the district, while fixed costs are covered by tax levies.

Whatever pricing pattern is chosen, many districts prefer to keep taxes and tolls stable for as long a period as possible. This practice is possible because most of a public water district's costs are fully stable, either in total amount or relative to the amount of water distributed. Many districts have built up reserves which can be drawn upon temporarily to cover excesses of variable expenditures over receipts.

The divivion of revenues between taxes and prices is more complex in urban water agencies. Many are parts of municipal governments, and where no separate tax is levied for the purposes of supporting the water department it is difficult to distinguish the tax implications of the revenue structure. Unlike the fiscally independent water agencies, municipal water departments rarely are supported by tax funds. On the contrary, water profits may be used may be used to support other municipal functions. Where water departments are used as instruments of taxation, the purpose may be either to overcome political resistance to expanding revenues via property taxes or to shift the tax burden as among or away from, the residents of the area. To the extent a profit-making water department sells outside of the city limits, it shifts the burden of local public services to non-residents.

To shift tax incident within a city by water pricing probably is seldom a conscious policy of its political leaders. These shifts are probably a byproduct of water profits sought for another reason: there is less resistance to this means of financing increased city expenditures. Commercial interests are often vocal on organized opposition to government expansion, and low-income property holders are reluctant to support any increases in property-tax rates. An "indirect-tax illusion" probably inhibits the low-income group from seeing the possible relation between taxes and water rates, and the way in which water-reat increased can work to their relative disadvantage.

Given the advantages of using utility revenues to support general city governments, the small size of such transfers is notable. Burlingame tries to maintain a constant contribution of water-department profits to the city treatury of $20,000 to 30,000 annually. Palo Alto's water department, along with those of other cities, contributes a sum in lieu of local property taxes to the city. In addition, these water departments commonly supply water free to the cities and at low charges to the local fire districts. In one case, the city of Vallejo, political issues of equity forced the abandonment of the use of utility charges as a source of general revenue.

Though some cities with integral water departments have used water revenues as a substitute for property taxes, those urban water agencies organized as independent governments have generally followed the contrary policy. Their financing practices closely conform to those of agricultural districts analyzed above. The East Bay Municipal Utility District, the North Marin County Water District, and the Contra Costa Water District, and the North Coast County Water District all levy taxes to supplement the revenue from water rates. The reason must frequently given for this practice is that of equity. Spokesmen argue that the benefits of water are widely dispersed throughout the comminity, and some of the greatest beneficiaries, eg. like stores, are among the lightest users.

The North Coast County Water District, like many of the agricultural agencies, levies a tax to cover capital charges and a toll to cover its operating and maintenance expenses. The North Marin County Water District levies a tax to maintain a sinking fund on its capital investment, which includes excess capacity installed in anticipation of growth of demand. Presumable the tax should decline as the user population grows to the anticipated levels, but instead of the agencies plans contemplate continuing reliance on taxes. 1. This behavior is typical of independent urban water agencies, which maintain a relatively constant tax revenue.

Taxes facilitate the financial operations of independent water agencies, though they complicate those of other public bodies in competition for the politically acceptable total tax take from a given property base. Though the directors of water agencies are usually drawn from the group of civic leaders of the community, they tend to develop allegiances to the welfare of their single-purpose agencies. This dedication to a single function is most marked in agricultural water agencies, but it is also strong in independent urban agencies.

Certain specific advantages accrue to agencies from the use of taxes to supplement water tolls. The interest costs on general bbligation bonds are lower than on revenue bonds, but the former can be used only by agencies which employ general taxing power. The use of taxes thus permits lower interest costs and slightly lower water rates than if all revenues came from tolls. Furthermore, the presence of taxes set to pay off general-obligation bonds tends to protect water districts against inroads by competitive suppliers. Even if an alternative supplier can offer a price lower than the average cost for an established agency, the presence of an irremovable tax can make an incremental cost to water users of the competitor's service higher than the incremental cost of water from the resident agency. Any shift between suppliers must then take the cumbersome form of controversial and costly referenda to leave one district and to join another.

C. Objectives in Pricing Agricultural Water

The preceding discussion of the components of water-district revenues has suggested some of the motives which affect the determination of their general level of revenue relative to costs and the structure of charges used to secure this revenue. These pricing motives and their effects more directly, with reference first to agricultural agencies is now being considered.

The conscious pricing policy of public water-agency managements in the agricultural sector, reflected in interview after interview, is to set tolls and tax rates so that current costs outlays will be covered, or occasionally to cover these costs plus a contribution to a "safe" surplus. Small increases or decreases in districts'tolls and taxes are explained in terms of changes in current costs.

Public water districts frequently increase their revenues in anticipation of higher future expenditures, partly to keep the year-to-year change in carges small, partly through a strong conservatism in financial matters. This explains some of the available facts about aggregate cost and revenue data for California water districts which would otherwise seem inconsistent with the hypothesis of pricing to cover current outlays. Not only have some districts built up substancial surpluses, but the rate at which total revenues of California irrigation districts have exceeded total expenditures has been as much as 10 per cent in recent years. Is this consistent with a reigning motivation of pricing to cover current costs? Part of the answer lies in the failure of irrigation districts to record the depreciation of assets as a cost, and some districts allow reserves to build in anticipation of these expenditures.

Pricing and incentives for water use

Besides covering current costs and providing a return to surplus, an irrigation district's charges are often set to affect the incentives of its water customers. These incentives cover a good many facets of the users' behavior, such as the amount of pumping from ground-water basins, the timing of draft upon surface water supplies, the construction and maintenance of conveyance facilities, the crops grown, and so forth.

Let us consider the Lower Tule River Irrigation District, one of the customers of the Bureau of Reclamation's Friant-Kern Canal. Its pricing policies reflect both the adjustments made by districts to the terms of water supply offered by the Bureau of Reclamation, and also the extreme importance of the conjunctive use of ground and surface water supplies. Districts holding permanent contracts for Friant-Kern water are largely assured a certain minimum annual supply of "Class 1" water for which they pay $3.50 an acre-foot at canal-side. Besides, in all but very dry years they may receive some additional supply of "Class 2" water, in uncertain quantities up to a maximum, at $1.50 an acre-foot. The average unit cost of the water is lower the more is taken.

The district normally varies its water toll between $2.40 and $3.20 an acre-foot with the supply of surface water available, raising it in dry years and lowering it in wet years. This achieves two objectives for the district. First, it controls the amount of water demanded by irrigators form the district. The pump lifts for the districts' irrigators vary from 60 to 200 feet, so that the out-of-picket costs of pumping (roughly four cents per acre-foot per foot of lift) are often within the range of variation of the water toll. Thus many farmers are near the margin of indifference between surface and ground-water supplies, making the demand elasticity for surface water (roughly the change in quantity demanded due to a change in force) very high over this range. A second desired result of this pricing policy is to cause of district's revenue to vary with its total costs as between dry and wet years. Thus, changes in the district's financial obligation to the Bureau of Reclamation can be met without changes in assessments or wide variations in the district's surplus. In 1958, a year when irrigation water was particularly abundant, the Lower Tule River district resorted to shifting from a water toll per acre-foot to a charge per irrigated acre. This maneuver reduced the marginal cost of surface water for the irrigators to zero, except for their own labor. It caused considerably greater quantity of water to be applied, as two crops that are widely grown in the district, alfalfa and permanent pasture, produce largely in proportion to the amount of water applied. On the highly permeable soils covering much of the district, nine to ten acre-feet of water could be applied during the year to permanent pasture. From the district's point of view, this had the desirable results both of causing considerable surface water to percolate through the root zone to the underground basin and of encouraging the growth of pasture grasses which loosen the soil and increase its permeability for further percolation.

The Lower Tule River district's practices are typical of those of many irrigation districts. The adjustment of water tolls to affect farmers' incentives for choosing between surface and pumped ground water is common throughout the important districts on the east side of the San Joaquin River valley. There are at least three reasons for this. First, the pump lifts for irrigators in much of this area are such that the average variable (and marginal) cost of securing ground water isin the same neighborhood as the average total unit cost to public districts of providing surface water. Second, nearly all irrigated farms in the area retain their own pumping plants and wells, either because of the receipt of surface water is relatively recent or because surface supplies have never been sufficient to last through the whole irrigation season. Third, the requirement of the Bureau of Reclamation that its contract customers pay for their total contractual supplies (after a development period) weather they take them or not compels the districts to develop pricing that induces farmers to use surface water when available and thus accomplish cyclical storage of water in the underground aquifers. 1. Thus, several districts, such as the Madera Irrigation District and Chowchilla Water District, both located north of Fresno, seek to set their water tolls equal to the average cost of private pumping in the district. On top of the necessity for setting a water toll low enough to induce farmers within reach of the surface distribution canals to use them, there is the problem of equitable treatment of district farmers who can and those who cannot use surface water. Under these policies, the farmer who operates his own pumps lays out about as much as one who depends on the district's supply, and no inequities are felt. The water toll, set at $2.85 (1964) serves the same double purpose of manipulating incentives to secure use of surface water and achieving equity between those who can and those who cannot use surface supplies. Defining appropriate normative criteria for appraising pricing practices in these cases of conjunctive ground-water utilization raises complex, separate questions; the appraisal of these practices is undertaken below.

The price structure of water districts often discriminates between different crops. Although sometimes unintentional, these differentials often reflect conscious policy. The adjacent James and Tranquility Irrigation Districts, located on a distributary of the Kings River both set their toll structure to serve rice at a lower toll per acre-foot than other crops. Rice is more tolerant of alkali than other crops, and this fact, plus the effect of heavy water applications to rice of leaching alkali from the soil, makes it an excellent crop for reclaiming alkali land. Another reason is that rice farming would be unprofitable in this area if rice-growers paid as much per acre-foot of water as do other crops; an element of value-of-service pricing is thus involved. A somewhat different form of discrimination between crops appears in the Merced Irrigation District's pricing system, under which the payment of the district assessment entitles a farmer to as much as four acre-feet per zcre. The district meters water delivered only to crops that normally use more than four acre-feet per acre, and these pay $1.00 for the fifth acre=foot per acre, $1.50 for all additional. Thus the marginal cost of surface water differs from crop to crop. It is zero for crops that are normally light users of water, but rises in steps for those crops that are heavy water users. In view of the fact that the Merced district has a high water table and some drainage problems which require pumping by the district, this scale of charges may be rationally designed to penalize crops which through heavy runoff or percolation contribute to drainage difficulties and increase drainage costs. Rising ground water due to havey water application to rice prompted the Jacinto Irrigation District (on the west bank of the Sacramento River) similarly to adopt penalty rates in the 1920's.

Many irrigated areas of the Central Valley lack storage facilities and so do not have equally good access to surface water through the irrigation season. Thus, water has an increasing imputed scarcity value as the season goes on. Some districts recognize this by setting the water toll lower in the early part of the season. Thus the Chowchilla Water District charges $2.00 an acre-foot after June 1, $1.50 before. Chowchilla is a customer of the Bureau of Reclamation, which makes Class 2 water available at $1.50 to the district only early in the season, so that the district's costs and revenues vary together. Irrigation districts maintain some pricing practices that affect incentives other than those directly relating to the use of water. The maintenance or improvement of the individual farmer's distribution facilities is often a concern to the districts, because it affects the efficiency of their overall operation and the apparent adequacy of their water supplies, e.g., Turlock Irrigation District sustains interest of the farmers in maintaining the distribution system and subsidizes new construction and maintenance projects of the improvement districts.

Equity in pricing agricultural water

Equity among various classes of citizens or customers of the district is a major factor governing pricing policies Often this is a matter of providing equal (or acceptable) treatment to persons who are located within a district s boundaries and subject to its assessments but are not direct customers for its water A tricky problem of this sort faced the Exeter Irrigation District in setting an equitable scale of charges to cover the relatively high costs of its high-pressure pipeline distribtuion system The district includes the city of Exeter, and city dwellers pay its taxes and vote in district elections. Tax rates cannot be raised too high without stirring a threat of rebellion by the town residents. On the other hand, water tables under most parts of the district are reasonably high and pumping costs to individual irrigators reasonably low; thus, water tolls likewise cannot exceed a certain range without inducing some irrigators to use ground water rather than the district's supplies from the Friant-Kern Canal. Thus, for land lying below (west of) the Friant-Kern Canal, which bisects the district, Exeter's toll is $5.00 an acre-foot. The tax rate is $2.00 per $100 assessed valuation, with irrigable land assessed at $150 an acre and non-irrigable alnd at $75. In addition, there is an annual standby charge of $3.75 an acre and $15 for each outlet or diversion from the distributing system, similar to a demand charge in urban water rates. The district devised this pricing system when it was seeking approval by the voters, including the city of Exeter, for a contract with the Bureau of Reclamation to install its elaborate distribtuion system. This proposition could be passed only if the district committed itself to assessments no higher than those needed to cover its general overhead, apart from repayment obligations on the distribution system. The pricing system of the adjacent and similar Ivanhoe Irrigation District provides a sharp contrast to Exeter's elaborate scale of charges.

Ivanhoe, having no town within its boundaries, covers similarly high costs by a $3.00 toll per acre-foot and a whopping $14 tax rate.[1]

Exeter's complex pricing system has proved useful for manipulating the quantity of water demanded by irrigators. In both 1956 and 1958, the district faced the prospect of being unable to sell all of the water it was obligated to purchase from the Bureau of Reclamation. In 1958, it adopted the device of raising the standby charge from $3.75 to $10 an acre, giving credit at the relevant toll rate against the extra $6.25 an acre for any water purchased. This device worked quite well and the district plans to use it in future wet years. Exeter Irrigation District had sold a portion of its entitlement to Bureau water to other districts before, but does not anticipate having to do so again.

Securing reasonable treatment of residents of a public water district who derive no direct benefit from its activities is the major equity problem affecting irrigation district pricing policy and in one form or another affects many districts. Many districts adjust their tolls and tax assessments to these conditions, and those which do not make such adjustments often seem to suffer chronic internal controversies, and often result in political upheaval.

Some types of pricing consideration seen by the districts as issues of equity may simply amount to recognizing differences in costs of service. Some districts serve a portion of their territory by gravity distribution but have to pump water to other users. The common practice of these districts, such as Exeter Irrigation District and Southern San Joaquin Municipal Utility District, is to charge the customers served by pumping more per acre-foot than the others, with the margin set to cover the cost of electric energy used in pumping. The difference amounts to $1.25 per acre-foot for Southern San Joaquin, $1.50 for Exeter. Again, the standard explanation offered for this practice is that a difference based on energy costs of pumping seems "fair". Many irrigation districts form improvement districts for the purpose of installing particular segments of the distribution system and levying the repayment obligation directly on those who benefit, but for solving the problem of allocating current costs this device is much less common.

Pricing by water districts is seldom clouded by issues of equity between growers of different types of crops, large versus small operators, or other such personal distinctions among direct customers of the district, but a few examples exist, e.g., discrimination in favor of rice growers sometimes seems to rest on a recognition of their lesser ability to pay.

Price discrimination against outsiders

One final objective frequently seen in the retail pricing of agricultural water is to charge district customers who are not citizen-members whatever the traffic will bear, charges to non-members would be set to maximize profits to the cooperative plant, and the available examples seem consistent with this procedure.

The Fresno Irrigation District serves some customers outside of its borders who hold legal rights stemming from an old ditch company. The district charges them a water rental set at $0.50 higher per $100 valuation than the tax rate for district members. Since the Fresno district has no toll, the average cost of water to outsiders is higher in the same proportion.

A similar pricing problem arises for districts which produce and sell hydroelectric power. When the power goes to an outside electric utility, it is generally sold at a price that will allow irrigation water to be distributed very cheaply or even free to charge to district members. This is true not just when power is sold to a utility, such as Pacific Gas and Electric Company, but also when the district retails electricity to its own residents (including urban households). Examples are found in the policies of Turlock and Modesto Irrigation Districts. Water Districts undertaking investments in dual-purpose water and power projects regularly seek to maximize their net revenue from power sales in order to reduce the cost of irrigation water.

D. Non-Price Allocation of Agricultural Water

The practices and objectives of agricultural water agencies in setting retail prices and the tax-toll balance have a number of implications for allocative efficiency. However, price is often not the sole device used to ration available water supplies among competing users in a district. Some irrigation districts ration water as a regular arrangement; in this case, water tolls have no direct normative significance as an allocative device.

The types of rationing used by agricultural districts depend on the nature of their physical facilities. In fact, the open-ditch and low-pressure pipe systems used by most agricultural districts lead to the use of short-run rationing by irrigators taking turns using the full flow of some segment of the distribution system. This is called the rotation method.

In many cases, tolls and taxes are juggled in ways described above to achieve at least a rough balancing of demand and supply over the season. Some district, however, ration by cutting back all order proportionally when they sum to more than the anticipated supplies. Districts which draw upon uncontrolled streamflow ration over-all demand more frequently.

Like pricing policies, a district's rationing policies can become an issue in internal disputes.

To what extent does rationing over-ride the influence of water tolls on irrigators' demand for water? The practice obviously has substantial significance in adjusting the short-run timing of demand for water within an irrigation season, but this is not particularly important. Its role in constraining total demand over an irrigation season holds much greater significance, and this also seems substantial. The general inclination of water districts to set tolls and taxes so that current financial outlays are covered cannot be fully compatible with the use of price as the sole rationing device in many cases. Because of the discontinuous nature of investments and the legal constraints precluding expansions of any kind for some districts, a price which bore the sole responsibility for rationing scarce water to competing final users would yield sustained surpluses for more districts than actually show such financial results. This conslusion turns our attention to the financial obligations of districts, and points to the older districts with no owned storage capacity and no contracts with major wholesalers. Their investments are either fully amortized or of insignificant scale relative to the quantity of water distributed, and thus their current operating costs per unit of water are quite low. For them, rationing is probably quite important in allocating water, and the water toll (if any) often understates the marginal value produce of water. For those districts having recent major investments or contracts with wholesalers (or both), tolls may serve to perform the bulk of the rationing function.

The bulk of agricultural water distributed by public districts in the Central Valley is probably not subject to regular, systematic and substantial rationing over the irrigation season. In most cases the marginal price of water to the irrigator can wield some influence on the quantity which he uses.

In short, the allocative effects of rationing on the distribution of water within districts does not seem conspicuously serious in the short run. (A more detailed discussion of effiency under rationing will not be given here.) Although undoubtedly, some irrigators waste water in the absence of a price incentive. However, rationing may combine with certain pricing practices to give misleading impressions about the demand of an area for additional water supplies, and thus contains important implications for the efficiency of capital allocation and of the water-rights system in the industry.

F. Agricultural Water Pricing and Economic Efficiency

The pricing patterns of some agricultural water districts reveal no apparent economic logic. The majority, however, seem to have built their charges on the basis of numerous considerations of equity and efficiency as seen from within the district. There is a vital question of the performance of these pricing systems, in terms of the level and timing of water use which they tend to induce and the allocation of water within districts.

To begin with the positive aspects of agricultural pricing performance, a majority of districts seem to use both a toll and a tax as sources of revenue. This combination of charges, when properly used, has certain optimal properties for allocating resources. When an enterprise operates with a constant marginal cost and some fixed costs, it will normally incur losses if it sets a single price for its product equal to the marginal cost. It is a familar proposition of public-utility pricing theory that in such cases only a two-part tariff can both return normal profits to the enterprise and permit customers to buy at a price equal to marginal cost. Those districts using both taxes and tolls possess the basic ingredients for such a system.

To what extent do actual water-district rates meet the exact requirements for a two-part tariff? Some render the toll meaningless as an allocating device by setting it on some basis other than per acre-foot of water, or by imposing rationing to regulate the volume of water taken. Still others strike a balance between tolls and taxes on the basis of issues of equity, efficiency considerations not related to the marginal costs of the district, or simply traditional practices and prejudices.

Nonetheless, a significant number of cases remain in which taxes are set to cover the district's bond interest and redemption requirements and some portion of the general administrative expenses, leaving maintenance and operations expenses plus the wholesale cost of water, if any, to be covered by the water toll. Michael Brewer's statistical finding of good correlations between changes in irrigation districts' administrative and maintenance and operations costs and their revenue from water tolls confirms this as the dominant pattern.

If districts' variable costs, principally operation and maintenance plus any wholesale costs of water, are a relatively constant linear function of the volume of water delivered, then water pricing would seem to come close in many cases to the theoretical norm -- at least in the short run.

Even where tolls are related to a district's variable costs and taxes to its fixed costs, some biases can creep in through accounting weaknesses. Depreciation accounting is in scant use, and money costs reflect payment obligations relating to fixed facilities often built at times of much lower prices. Not only do districts tend to under-estimate their total costs and engage in capital consumption, but they also probably underestimate the current level of average variable or marginal costs.

Besides those districts using both a toll and a tax, a few others may also employ pricing which approaches optimality on the basis of marginal-cost principles. Several districts in the Sacramento Valley with relatively unlimited supplies of water delivered through gravity canals probably have marginal costs very near zero, and thus price appropriately by using a tax but no toll. On the other hand, similar districts in the area employ a toll but no tax.

Beyond the general principle of setting tolls in relation to variable costs, a series of complex issues arises concerning the appropriate interpretation of variable costs for some districts. The joint management of ground and surface water supplies provides the most important of these, since the two sources are alternatives for the bulk of Central Valley irrigators, and many districts' tolls take this into account.

Come simple and "unrealistic" theorizing becomes helpful. Assume first that the ground-water basin underlying a district is essentially a tank with fixed capacity, and without autonomous inflows or outflows. Assume that spreading operations (undertaken at some cost by the district) can replenish the ground-water basin, but no water applied to crops by irrigators percolates to the basin. The District buys water from a wholesaler at a fixed price per acre-foot in the summer, and at a fixed and substantially lower price in the winter and spring when no irrigation demand exists; sales by the Bureau of Reclamation from the Madera and Friant-Kern canals are subject to such an arrangement. In the long run, the district will minimize water costs to its members by purchasing winter water and causing percolation to "fill up" the ground-water basin, if the winter-summer differential in wholesale prices exceeds the costs of percolation plus pump retrieval per acre-foot. In the irrigation season, higher-cost summer water should be purchased by the district only to the extent necessary to prevent the marginal costs of ground water (district cost of winter water plus incremental spreading and pumping costs) from exceeding the marginal cost of surface water (district cost of summer water plus incremental costs of surface distribution).

Achieving this optimization would require some special tactics for the district because of an institutional quirk: irrigators are very rarely charged for private ground-water extractions in Northern California, and so the private cost of ground water (marginal pumping costs) falls short of collective costs to the district (irrigator's pumping costs plus the district's wholesale price and marginal spreading costs). If the district set a toll on surface water equal to the higher marginal cost, ground water would be used excessively. The optimal solution in this case would be a pumping tax to equate private and total costs of ground water; if the pumping tax is ruled out, then a close to satisfactory solution would be to lower the charge on surface water (loading the uncovered costs onto a tax) and to use rationing (if necessary) to prevent over-intensive use of water.

In the actual circumstances faced by San Joaquin agricultural water districts, the amount of percolation to ground-water is more or less technologically fixed, and the supply of summer water to a district purchasing water from a wholesaler is rationed. These facts, plus assorted uncertainties (e.g. optimum ground water levels), make the common practive of keying tolls on surface water to the level of private pumping costs look reasonably sensible.

Most other questions about districts' tax-toll adjustments are simpler to analyze. Where a district's marginal cost of service to one group of customers significantly differs from that to another, the difference usually shows up to some extent in the tolls charged. (e.g. pumping costs to the district are often put in at their incremental cost). On the other hand, many opportunities for appropriate differentials in tolls are undoubtedly missed, and our appraisal generally tends to the conclusion that while the efficiency of agricultural water pricing at retail is low, it could be worse.

Before leaving this appraisal of the efficiency of agricultural water pricing at retail, we should note some factors which may have wider significance than for allocation within districts.

1. Districts' unwillingness to sell water to outsiders without a price differential (if then) supports the likelihood that excessive use in districts with "strong" water rights goes on unimpeded.

2. Rationing means that the prevailing tolls do not directly test the marginal productivity of additional supplies of water; the increase needed to eliminate excess demand might be either small or large.

3. Analysis of water demand suggests that water use may be more closely related to average total unit costs (taxes plus tolls) to the irrigator than to average variable costs (tolls alone).

Thus, the chances of districts' investment decisions being seriously distorted by their pricing practices seem somewhat remote. The same conclusion, of course, need not hold with regard to federal and state agencies undertaking large-scale water storage and transfer on a wholesale basis, under conditions where commercial feasibility of projects is not prerequisite.

G. Pricing Municipal Water: Objectives and Pressures

Let us now consider the motives behind urban water pricing and the pressures that shape it. The range of influences playing upon urban water price structures and the possibilities for success or failure in equity and efficiency in designing pricing systems are greater than for agricultural water districts. Nonetheless, water prices hold a good deal less significance for the urban economy than do agricultural water prices for irrigated farming. Partly as a consequence, we can tell less about the behavioral objectives underlying urban water pricing systems.

Objectives of Urban Water Pricing

Setting revenues to cover costs constitutes the most basic rule for urban agencies, as for agricultural ones.

An immediate qualification arises for those cases in which city water bills are used as an instrument of taxation, as was described above. Costs again should be interpreted as financial obligations, for the accounting practices of urban agencies focus rests on a historical-outlay concept of cost.

This measure of costs can diverge greatly from the economically relevant one of the benefits of other kinds lost to society as a result of using resources to provide water to a given class of users.

The historical costs of land procurement give no clue to the value of the resource being used in water supply.

The practice of setting a price differential between those who are residents of the territory of the relevant government and those outside the area is even more prevalent than among agricultural districts.

Here we are reminded of the characterization of public water agencies as cooperatives, but in the urban sphere more is at stake than just the economic welfare of member-customers.

Except for the East Bay Municipal Utility District, the bulk of urban water in the San Francisco Bay area is supplied by city governments. Although their policies in regard to charges to outsiders differ markedly, almost all of them discriminate.

e.g. Antioch and Martinez charge outsider twice the price to insiders, while Daly City's outside prices are only 25 per cent higher than those for insiders. The facts of differentials are clear but the reasons are not.

Three justifications are commonly given for the inside-outside differential. The one which would seem to be thr most specious is that it costs more to service those outside the city limits. Though this might be true occasionally, it is equally true that substantial differential costs within a city are rarely matched by differential prices. A second reason which bears more weight is that the residents of the city pay taxes to support the municipal government, and therefore the outsider must pay a higher price to compensate for his lack of tax liability. But urban water systems are usually not tax-supported and in fact sometimes collect revenues for the general funds. A third reason which is unofficially but widely accepted is that a differential is a device to encourage annexation. Some cities in the San Francisco Bay area have aggressive plans for territorial expansion, and water is one of their instruments.

Like agricultural districts, urban water departments create a few price differentials between customer groups because a sense of fairness indicates that substantial cost differences should be reflected in prices. Except for fire protection, however, such price differentials are small and probably more rare than in the pricing of agricultural water. The more common pattern is for a city to establish a single rate structure which, on the average, covers all the costs of water distribution. The result of this averaging is a subsidization of the use of the high-cost water. For many cities located along southern San Francisco Bay, high-cost water is a seasonal phenomenon, since they use San Francisco water to supplement their supplies only during the dry period. It would be appropriate for them to charge seasonally differentiated prices to reflect the cost differentials, with the expectation that they would thereby reduce the demand for more expensive water. But none of the urban systems interviewed uses seasonal price variations.

Differentiation by height of pump lift would be another basis for varying prices with costs (e.g. Burlingame). Despite these isolated instances of rate differentials justified by costs, the general practice is a uniform rate structure independent of elevation, distance from reservoirs, or other sources of cost differences.

The two major deviations from a uniform retail price for urban water are fixed monthly charges for connections and tapered tolls or commodity charges. The connection charges increase with the size of connection, and the commodity charges decline with the volume of water taken. Water departments apparently create these structural elements in water charges because they believe that a more suitable relation of prices to costs results. The trouble lies not in the motive but the achievement: as we shall see below, these structures typically rest upon faulty analysis.

Finally, one objective in setting retail water prices which plays an important role among agricultural agencies holds sporadic importance in the urban sector. That is the adjustment of charges to manipulate the incentives for individual users to draw upon the ground-water basin. In much of the San Francisco Bay area, ground-water is either not used at all, or is pumped by water agencies rather than by individual users. (However, both Alameda and Santa Clara counties contain districts which both import and sell surface water and also replenish the underground aquifers drawn upon by individual farmers, industrial firms, and municipal water systems.)

One device proposed, the pumping tax, would serve potentially to fill a gap in the types of pricing devices used by agricultural districts, a gap shown in the preceding discussion of their pricing practices. Legally, a pumping tax constitutes a true tax, since the ground water is not viewed as the "property" of the government agency which has helped to replenish it. In fact, current proposals contemplate levying the tax on the basis of the amount of water pumped, so that it becomes the economic equivalent of a toll. As in agricultural agencies, such charges are often set primarily in the light of equity considerations.

In Santa Clara County the problem is complicated by the many independent municipal systems which tap the ground supplies and by the presence of competitive wholesalers.

In Santa Clara Valley the bulk of water used has been pumped from ground storage, with growing wholesale purchases from the city of San Francisco, the State of California and the Bureau of Reclamation, and these supplementary imports percolate into the underground basin.

The financing includes a countywide tax of $0.105 per $100 of assessed valuation, a pumping tax of $5.00 per acre-foot of agricultural water and $10.00 per acre-foot of water for municipal and industrial uses. The justification for this charge is that it will provide any incentive for cities to abandon the use of ground-water supplies

While a pumping tax could well constitute an efficient allocative device in such a situation, actual charges will rest upon complex political pressures and objectives that may not achieve an efficient result.

Urban water pricing and competition

An element significantly affecting urban water pricing which is not present in the agricultural sector is potential or actual competition. In urban areas, however, the access of customers to alternatives usually varies sharply, and so its influence is likely to affect the advantages which the rate structure offers to different customer groups. Furthermore, overlapping retail water supplies seem more common in urban areas than in the agricultural sector.

The water users most likely to employ competitive threats against their supplier are those to whom water rates or quality may make a large economic difference, and industrial customers being typically the much heavier water users are the most likely one case of successful pressure of industrialists upon the water rates has involved the East Bay Municipal Utility District (EBMUD), and Standard Oil Company of California who in 1949 decided to develop a competitive supply.

In 1949 the voters of Richmond approved through the formation of the Southwest Contra Costa County Water District (SWCCWD).

*Refer to pp. 86-89, Report, Margolis

H. Urban Water Pricing and Economic Efficiency

Unlike the pricing systems of agricultural water agencies, urban pricing systems generally rest on formulas and procedures which are well known and widely used within the public-utility industries. The bulk of their costs are the fixed costs of storage, treatment, and distribution systems.

If the physical plant of an urban water system can be viewed as continuously variable in scale, so that incremental costs are defined for each aspect of the output or capacity of the system, then rules can be stated for an efficient pricing system as an elaboration of the marginalist principles developed in Section 1 and in the preceding appraisal of agricultural water pricing. The components of an urban water pricing schedule for the individual customer should include: (1) a fixed charge per period of time to cover customer costs and a proportional share of fixed costs not otherwise allocated; and (2) a quantity charge which covers only incremental operating costs, if none of the capacities of the system is being fully used, or operating costs plus the incremental capital cost of any capacities which are fully utilized.

Rules of this type have often been proposed for the pricing of water and related municipal utility services, yet have obviously made rather little headway in practical application. Two economic phenomena clearly stand in the way of their acceptance: costs that are incurred jointly in serving more than one customer; and units of fixed plant that can be built only at one scale or added only in large, discontinuous units.

In facilities subject to joint use can be varied continuously in scale, their presence does not significantly change the applicability of the marginal pricing principles suggested above. They do cause the marginal cost of supplying a given quantity of water to one customer to depend on the amounts taken by others, so that a shift in the demand of the others can shift the marginal-cost function of serving the one, and thus the appropriate price to be charged to him. Apart from this effect, the basic rules for efficient pricing are not altered by the existence of joint costs in continuously variable facilities, although the interrelation of the marginal-cost functions for different users of a joint facility might be felt to raise issued of equity.

More destructive of the marginal approach to pricing is the existence of facilties which are fixed in scale or can be varied only discontinuously. The distribution of such costs becomes a matter of equity and not of efficiency, and it should be handled so as to avoid interfering with any other components of charges which are designed to secure some objective of marginal adjustment.

Even if units of physical plant are variable in scale, such variations may perforce occur in sufficiently discontinuous fashion or under such constraints that maintaining a pricing system related to incremental costs, aside from operating costs, becomes impractical. The most reasonable approximation to a correct pricing system may then reflect a separation of capital and current overhead costs into classes of separable and common costs which can reasonably be allocated to particular users or groups of users, on the one hand, and truly joint costs, on the other. Prices can then be set to cover the average costs imputable to each user plus a proportional share of the truly joint costs. Such a relatively simple procedure would produce the same result as pricing according to marginal-cost principles if costs are approximately constant. Furthermore, if operating costs are covered by a charge proportional to the amount of water purchased by each consumer, the allocated joint and separable costs are appropriately added on as a fixed or demand charge, and a two-part tariff again remains the best form of pricing.

One qualification to these propositions about pricing in relation to marginal costs and the proportional allocation of joint, fixed costs comes from the theoretical case in which price discrimination may be justified. Under certain conditions, the use of price discrimination may permit the construction of a joint facility subject to decreasing costs to a larger scale than if each group of customers is charged a sum equal or proportional to incremental costs. The effect of the discrimination is to favor groups with a relatively more elastic demand and increase the average revenue attainable from the sale of any given output. The expansion of the fixed plant thus warranted may reduce unit costs and permit a lower charge to each group than if discrimination were not used.

Demand and quantity charges

The urban water pricing systems of the San Francisco Bay area bear little relationship to any pattern that would lead to the efficient use of existing capacity or the proper incentives for its expansion. Let us consider some of the problems involved. (A table showing the rates of the San Francisco Water Department is given, as an example in the Appensix). Almost all Bay systems employ a fixed charge per customer that may or may not be related to customer costs. The fixed monthly charges may be a reasonable estimate of the costs of connections, billing, meter maintenance and the like.

The other component of charges to the main classes of consumers--residential, commercial and industrial--is a commodity charge with a declining block rate. One may justify a declining block rate as a device for covering the total costs of the system while charging a price for the last unit of water taken equal to its marginal cost. But in practice the block rate does not work out that way, nor is it usually justified in those terms. A substantial price differential prevails by type of customer. Unless these differentials are related to cost differentials, there will be an inefficient allocation of water between customer, and possibly excessive investment.

The demand of large industrial consumers is said to fluctuate less than that of residential users, requiring relatively smaller reserve capacity in the system. This may hold for some cities, but it does not for San Francisco, for example. Of course the relevant factor is not the variation in demand of the respective classes but the demands placed by each group at the time of peak utilization. If residential demand during the peak demand period is more uncertain than industrial demand, requiring greater reserves to be held against it, then costs could justify a price differential. But this differential would not extend to non-peak periods, in which a uniform price should be exacted from both broups unless other cost differentials are present.

Distributional economies probably exist for serving large industrial consumers compared with small residential consumers, although the distributional reservoirs and pipeline systems of most water systems provide integrated service to these two customer groups and the costs of serving them cannot be separated.

Price differentials between areas

Cities typically impose higher water charges for service outside their boundaries, yet the differentials seldom seem to rest upon a satisfactory economic analysis.

Discrimination through special rates

Certain urban water rates quoted to special types of users often constitute a possible source of inefficient pricing. Most cities provide free water to their own governmental agencies. Some of these departments -- parks and playgrounds, fire, street cleaning and maintenance -- are heavy consumers of water. This practice not only loads the cost of general governmental services on the water user, but it also tends to encourage inefficient water use. Another water use, fire protection, involves slight consumption of water but imposes a substantial cost on the system in the form of extra capacity, a cost which is rarely related to the payments exacted from the beneficiaries. The revenues collected from the provision of the hydrants are probably well below the costs of providing the service. In Palo Alto, it has been estimated that as much as one-fourth of the total investment in the water system is chargeable to the fire protection function. However, only two percent of its operating revenues came from hydrant rentals.

The underassessment of direct fire protection costs means that these come to rest on the water purchases of general consumers. The practice tends both to shift the incidence of the costs of fire protection and to render the community unaware of them. Expenditures on an improved water system are often justified with the argument that it will cost the community little or nothing, since the outlay for extra storage, pumps or distribution capacity will be offset by the reductions in fire insurance rates.

In the aggregate it may often be true that the offset insurance savings may be considerable, but the savings will not go entirely to the same parties who pay for the increased capacity. The largest gainers tend to be the commercial interests, with large flammable inventories and very low water consumption. Among residential consumers the bulk of the savings will go to the upper-income groups, who have higher value homes but whose water consumption stands little above the average.

Since the fire-protection costs consist mostly of maintaining augmented capcity, they would best be financed through a property tax levied by the fire district.

In final appraisal, the pricing systems of urban water agencies resemble those of agricultural districts in having certain features appropriate to ideal resource allocation. However, such formal structures of charges seem to be applied largely without any basis in a correct economic analysis of their relation to costs. Furthermore, the use of tapered rates and special rate schedules for a few users creates significant possibilities for price discrimination between user groups, in relation to the long-run marginal costs of serving them. Distortions of water allocation as between classes of urban consumers thus may have greater relative importance than those between agricultural users. But for both groups of agencies deficiencies in retail pricing practices and resulting allocational distortions are varied and important.

Obtained from Mr. Warren, DWR, Sacramento, September, 1965

Note on Industrial Water Rate Information; Source: Direct Extract from DWR files, Sacramento*

There is no complete information on water rates in California for industrial uses, with particular reference to surface water supplies. Water rates vary throughout California, depending upon physical conditions, and on the pricing policies of the respective water wholesalers and retailers.

Information on water rates readily available to the Department is principally related to large wholesalers for agricultural and municipal water (1,500 to 1,500,000 acre-feet per year) and certain domestic rates. Although the latter rates cannot be considered directly applicable to indusrial purposes, they are indicative of the probable relative industrial water rates in different areas of the State.

The Department is currently constructing the State Water Project to deliver water to contractors in the Central Valley, San Francisco Bay, Central Coastal, and Southern California areas of the State. Under the State's pricing policies, the rates to a given wholesaler will be the same whether the water is applied for industrial, municipal or agricultural purposes. Although the charges are made on a rather complicated six-part basis, they are estimated to be equivalent to the following unit rates over the project repayment period for the following sample areas:

Area	Cost per acre-foot
Sacramento Valley	$ 7
San Joaquin Valley	
Vicinity of Kettleman City	13
Kern County	16
San Francisco Bay	
Solano County	26
Napa County	15
Alameda County	21
Santa Clara County	24
Central Coastal	
Santa Barbara County	63
San Luis Obispo County	57
Southern California	
Vicinity of Palmdale	38
Vicinity of Victorville	47
Vicinity of San Bernardino	54
Vivinity of Castaic	45

The following wholesale rates are generally applicable to the water sold from the major federal projects constructed by the Bureau of Reclamation in California:

Area	Cost per acre-foot (municipal and industrial use)
Sacramento Canals Service Area between Red Bluff and Woodland	$ 9
Contra Costa County	10
Santa Barbara County Goleta-Carpinteria	35
Eastern Kern County (future construction)	23
Eastern Sacramento County (future construction)	14

The following domestic rates for cities were noted in 1960 (based upon 50,000 cubic feet per month) and may be of interest:

Southern California (Average $61)

Range of costs per acre-foot	Cities	Rates	Source of Water Wells %	Source of Water Surface %
$30 to $40	South Gate	33	100	0
	Oceanside	37	68	32
	Lynwood	40	100	0
	El Monte	31	100	0
	Azusa	36	80	20
	Compton	35	100	0
	Indio	35	100	0
$40 to $50	Arcadia	53	80	20
	El Centro	43	0	100
	Manhattan Beach	50	21	79
	San Fernando	41	100	0
$50 to $60	Alhambra	59	100	0
	Burbank	54	83	17
	Glendora	57	100	0
	La Habra	51	5	95
	Onterio	56	100	0
	Redlands	57	90	10
	Riverside	53	75	25
	San Bernardino	54	82	18
	Santa Monica	60	15	75
	Torrance	60	15	85
$60 to $70	Anaheim	62	60	40
	Inglewood	67	40	60
	Los Angeles	66	21	79
	Monterey Park	66	100	0
	Monrovia	68	100	0
	Newport Beach	63	1 0	100
	Pomona	61	85	15
	Santa Ana	67	50	50
	Uplands	64	100	0
greater than $70	Hawthorne	73	90	10
	Glendale	74	87	13
	Beveraly Hills	85	70	30
	La Verne	72	95	5
	Pasadena	72	44	56
	Long Beach	78	61	39
	San Clemente	131	100	0
	San Diego	125	0	100
	Whittier	77	100	0

San Francisco Bay Area (Average $85)

Range of costs per acre-foot	Cities	Rates	Source of Water	
			Wells %:	Surface %
$30 to $40	Napa	37	0	100
$40 to $50	Fairfield	45	25	75
$60 to $70	San Bruno	66	100	0
	Antioch	68	0	100
	Santa Clara	60	100	0
$70 to $80	East Bay Area	71		
Greater than $80	Sunnyvale	83	82	100
	Pittsburg	84	0	100
	Burlingame	107	0	100
	Daly City	99	0	100
	Hayward	95	20	80
	Hillsborough	128	0	100
	Palo Alto	97	40	60
	Redwood City	114	0	100
	Vallejo	94	0	100
	San Francisco	94	0	100

Central Valley (Average $35)

$10 to $20	Atwater	19	100	0
$20 to $30	Winters	22	100	0
	Porterville	23	100	0
	Colusa	23	100	0
	Lodi	26	100	0
	Turlock	28	100	0
	Yuba City	30	100	0
$30 to $40	Tracy	38	100	0
	Fresno	34	100	0
	Gustine	32	100	0
$40 to $50	Davis	41	100	0
	Modesto	50	100	0
	Ripen	45	100	0
Greater than $50	Sacramento	61	14	86

Information concerning industrial water rates may best be obtained from the California State Chamber of Commerce, 350 Bush Street, San Francisco 3, California.

SECTION 4: Note 2

Water Pricing in Southern California
A note on M. W. D. practice

The following Note is an abridged extract from, "Water Supply, Economics, Technology and Policy," by Hershleifer, Dehaven and Milliman.

"In general, water in southern California has been made artificially cheap to users in comparison to the costs of providing increments of supplies. This underpricing is especially serious when measured against the cost of water that the state planners wish to transport to the area via the Feather River Project. In Southern California, in addition to general underpricing of water, discriminatory pricing in favor of agriculture appears to be responsible for some degree of misallocation in water use.

It is, unfortunately, very difficult to secure statistical breakdowns of water use in the area, because of the multiplicity of political units and private companies and the lack of any system of central reporting or even standardization of reporting methods. Analysis (Harris F. Seidel and E. Robert Baumann, "A Statistical Analysis of Water Works Data", journal Amercian Water Works Association, XLIX (December, 1957, 1531-32) of water rates at the retail level in Southern California are lower than those found in many parts of the United States where natural water supplies are much more abundant.

The rates for all but one of the reported cities, decline as water use increases; most cities in Southern California employ system of declining of "promotional" rates. It has been pointed out that there was some justification in terms of cost for rates reductions to large users. Primarily, large users require less of a distribution network than do a group of small users taking the same quantity of water in the aggregate; billing and collection

expenses are less; maintenance and wastage will presumable be less; and, finally, there may be less frictional pressure loss. A proper study of the question of whether these declining rates to large users are actually justified by cost differences, or whether they constitute special favors to large water-users, would involve a careful study of the factors mentioned above.
Note: that some of the cost savings in serving larger users can be and already are reflected in reduced charges for initial connection to the system and in smaller recurrent fixed charges (per unit of connected capacity).

"Promotional" rates not based on cost differentials may be somewhat justifiable in situation where the system has idle capacity, so that the marginal cost of delivery is small; they would represent a form of price discrimination designed to augment revenues while keeping marginal prices low. But in areas approaching full use of their current water-supply facilities and so considering the importation of expensive new supplies, the excess-capacity argument does not hold. It would seem logical at this point for responsible authorities to reconsider their structure of declining block rates. As water is made more costly to them, of course, large users will be induced to make more economical use of existing supplies.

Most municipal water systems, including those in Southern California, tend, as we have discussed earlier, to price water on the basis of the average cost of production and distribution. Such pricing is correct is situations where the average costs are relatively constant. But, where average and marginal costs diverge, average-cost pricing will lead to inefficient use. To illustrate, we will assume that the incremental production costs of water supply for the city of Los Angeles are as follows:

Source	Amount in acre-feet	(per acre-feet) Production cost
Aqueduct	320,000	$ 2.00
Local Wells	105,000	10.00
MWD water	38,000	25.00
Total	463,000	

On the basis of these figures, which are roughly indicative, the average production cost of water for Los Angeles is $5.70 an acre-foot. Yet, because all increases of water use in Los Angeles are being satisfied by MWD water, it is clear that the marginal cost of water to the city is $25.00 an acre-foot. To the extent that the city bases its current water prices upon the average cost of water, increased water use is taking place at prices that are inadequate in terms of the unit costs of the extra water needed to supply the increased use.

M. W. D. OF S. C. Price

We indicated above that most of the cities using Colorado water are buying it from the M. W. D. at $25.00 an acre-foot. While this is approximately correct, the actual pricing schedule used by the M. S. D. is somewhat more complicated: Just before 1960 softened Colorado water was sold at $25 and $22 an acre-foot west of the LaVerne softening plant, and the untreated or raw water is priced at $15 and $12 an acre-foot and delivered to district members east of La Verne. The lower price quoted for water that is to be used for recharging underground aquifers or for agricultural purposes. (the M. W. D announced in March, 1960, a new per acre-foot price schedule to begin to take effect in July of that year. The major changes were reduction of the softening differential from $10.00 to $8.00; an increase in the basic rate for water before softening in the amount of $6.00, to take effect in three equal annual steps; and a widening of the differential (in the form of a smaller increase than that in the base rate) favoring agricultural and replenishment uses. The final rates will be (as of 1963) $21.00 and $14.25 for untreated water, and $29.00 and 22.25 for the treated, the latter figure in each pair representing the preferential rate. Because of the late date of the change, our text discussion is based on the old rate schedule). The $10 differential between softened and unsoftened water is supposed to reflect the cost of the softening treatment. (while $8.00 is now quoted as the cost of softening (see N, 34), the quality of the service appears also to have been reduced. Water has recently been softened only down to the still rather hard level of 167 ppm instead of to the 125 ppm level previously achieved.) Most cities are served the softened water, a principal exception being San Diego.

Most of the agricultural use of M. W. D. water takes place east of La Verne and is now charged the $14.25 ($12.00 in 1960) price. In 1959, agricultural water use was about 19 per cent of M. W. D. sales, or approximately 100,000 acre-feet. The rationale of the discriminatory price schedule favorable to agricultural use of water (and water for recharge) is not altogether clear. Presumable, the M. W. D. is interested in increasing water sales as long as the extra sales more than cover marginal cost; a policy of low prices makes good economic sense as long as excess capacity exists (marginal cost is low). But the M. W. D. embarked upon a $200 million expansion program, to be completed in 1960, in order to bring its aqueduct facilities up to the ultimate capacity of 1,200,000 acre-feet a year, the previously effective capacity being only half this figure. This expenditure amounts to over $300 per acre-foot of capacity added. On the basis of a seventy-year life and full-capacity deliveries throughout, and using a interest rate of 3.5 per cent, these incremental capital costs would amount to $12.82 per acre-foot of water (note that we are correctly assessing no charge for the previous or sunk capital investment required to build the dam, secure rights-of-way, etc.). To this figure we must add the operating costs of transporting the water. the M. W. D. also pays the federal government 25 cents for each acre-foot of water diverted from the river.

If incremental operating costs total to approximately $15 an acre-foot, the full incremental cost of Colorado water would be in the neighborhood of $30.00 ($28.00, 1960) an acre foot, before softening, and (accepting the $8.00 differential) $38.00 ($36.00, 1960) an ccre-foot for the softened water. Furthermore, if we calculate the capital costs at more realistic rates representing the marginal opporuunity cost of capital, these figures become substantially higher. Even at 6 per cent, a low estimate of the marginal opportunity rate, the incremental capital cost is $20.34 per acre-foot, and the full incremental cost becomes about $35 per acre-foot, unsoftened, and $43.00 softened. At our generally recommended rate of 10 per cent, the corresponding figures are $33 for the unit capital cost and $48 and $56 for the unsoftened and softened full incremental costs. It would seem that current prices for M. W. D. water are lower than the cost of the incremental costs. It would seem that current prices for M. W. D. water are lower than the cost of the increment of supply; the new construction should have been preceded by an increase in rates. (The recently announced price increases mentioned above have certainly come too late; they appear to be a reflection of the costs already incurred for the new construction).

Current M. W. D. revenues (1960) from water sales, are insufficient to cover current operating and capital outlays. M. W. D. cost calculations make inadequate provision for depreciation, assessed only at the rate of $2.00 per acre-foot). Funds to cover interest charges (and also bond repayments) are provided by taxes which the M. W. D. levies on its members. Deficits are mainly a consequence of a low-price policy designed to promote the use of idle capacity and, when the new construction is complete the M. W. D. system will be overbuilt again, and the current level of rates will be approximately representative of marginal cost until the next new construction seems required. New construction should not have taken place until the price for rationing existing supplies exceeded the unit cost of the increment of supply.

The extent to which the M. W. D. have relied on its taxing power to carry the capital and operating costs of the Colorado River Adueduct is enlightening because it may serve as an example of how water planners can overestimate future demands by ignoring important economic factors.

One result of the reliance upon taxation has been that cities with relatively large assessed valuations, but using relatively small amounts of M. W. D. water, have tended to carry the project. The most important example is the city of Los Angeles, which by the

1958-59 year had paid a total of $167 million in taxes - about 50 per cent of all taxes collected by the M. W. D.--yet had purchased only some 8 per cent of the total water sold by the District. (We should point out that the tax payments are presumable buying the city a future water right; entitlements to M. W. D. water when the aqueduct was to operate at full capacity it would be based upon the proportion of taxes paid by each member in relation to total taxes collected.

With exception of a few cities (e.g., Burbank, Pasadena, Glendale, and San Diego), the common municipal practice is to add the M. W. D. tax levies directly to property tax bills and not to show these tax levies in water-department accounts or pay them out of water-department revenues. The result is that costs for the provision of an expensive water supply do not show up as water costs and are not paid directly by water-users. Water taxes should at least appear in water-department accounts, so that they can more readily be seen for what they are--costs of water supply. If this is done, the electorate can better decide how these costs should be borne--by property-owners or by water users.

Retail prices reflecting the marginal cost of water supply would change the pattern of use as well as the total amount of water consumed.

Agricultural use of water is probably more sensitive to changes in water prices than most other kinds of use. We think that it is not unreasonable to estimate that at least one-half of the 800,000 acre-feet per annum currently used for irrigation in the South Central Area would be uneconomic if water costs at the wholesale level not counting the costs of delivery to the farmer's headgate, were on the order of $20 - $30 and acre-foot. At this price range, only citrus, avocados, and some truck crops would be economically feasible. The growing of alfalfa, pasture, hay and grain, and some orchard crops would definitely appear to be submarginal.

Apartment dwellers in southern California are not charged directly for the water they use. The almost universal practice is for the landlord to provide "free" water to the tenant, with the result that the marginal cost of water to the user is zero. We have not studied what the cost of individual metering would be for apartments, but is is evident that increases in retail water prices and an abandonment of "promotional" rate schedules would increase the advantage to owners of installing apartment meters.

Many industrial and commercial firms in the Southern Californian region use large amounts of water for cooling purposes on a once-through basis without recirculation. At prices that are currently being charges for water supplies in Southern California, particularly to large investment in facilities for reuse of water.

In Los Angeles per capita use is about 168 gallons per person per day. In this connection, it is interesting to note that the

San Diego area has higher average annual temperatures and lower yearly rainfall than Los Angeles! The principal difference between the two cities is that water rates at the retail level in San Diego are almost double those in effect in Los Angeles. (In northern California the city of San Francisco also has retail prices almost double those of Los Angeles, and consumption of only about 100 gpcd.)

In short, then, we conclude that the South Coastal Area is a region where water rates that understate marginal water costs have led to profligate use of water, thus creating an apparent "need for new supplies when what is more urgently required is economical use of existing supplies.

Forecasts of population growth are in almost every case called upon by "practical" planners to justify large water-supply projects in excess of currently visible needs. The most crucial point to appreciate in reference to population predictions is that there is no such thing as a "scientific" forecast.

There is, as well, some interdependence between water availability and cost, on the one hand, and population growth, on the other, though the actual relationship is often misunderstood. If true water costs in an area are high--this is to day, if water is simply hard to come by--that will be one of the intrinsic disadvantages of a region which will limit its growth, unless outside agencies (e.g., the Bureau of Reclamation) can be induced to subsidize artificial local development by paying for the local water supply with funds collected elsewhere. In the absence of such an external subsidy, the region cannot escape the limitational scarcity of water. A common confusion is to believe that a domestic water subsidy paid with local funds--that is, a low water price with deficits made up by local taxpayers--will have the same effect as an external subsidy. This is incorrect; a purely domestic subsidy merely twists the direction of local development toward water-intensive, low-tax-base industries which represent quite inappropriate forms of expansion for a water-scarce area. In the circumstances of Southern California, water subsidies typically favor irrigation agriculture and possibly large industrial users as against small residential users. In addition, urban water use, in most cities of Southern California, is subsidized by property taxes.

First with respect to acquisition of water rights, purchase of partial allocations would be much less costly per unit of water acquired than purchase of full rights. That this must be so is evident from the following consideration. Suppose that, for a given farm or irrigation district 25 per cent of the attached water rights were purchased. The farmer would almost certainly remain in business. He could either reduce the application of water to his initial crop, shift to a crop demanding less moisture, or cut back on his acres irrigated. Alternatively, he could make investments designed to eliminate waste by seepage and evaporation (often reaching 50 per cent at canalside) and thus indirectly recoup some of the water lost by sale. In any case, the net return to farming operations will have been somewhat reduced, in exchange for an increment in revenue from water sales. If the sale is voluntary, the gain to the farmer from water sales will exceed the loss in farming. In contrast, purchase of full water rights will require abandonment of farming or, alternatively, a radical shift to dry culture--and only a very handsome offering price for the water is likely to induce an agreement to sell. In somewhat more technical language, we may say that the value placed upon the last unit of water applied (the marginal value in use) is less than the average value in use.

Hirshleifer believes that something like the last 25 or 30 per cent of the Colorado Desert irrigation rights could be purchased for under $15 an acre-foot per year. The districts now charge such low prices for the Colorado River water (in the Imperial Irrigation district, $2.00 an acre-foot) that the farmer has little incentive to take measures to avoid water waste or to concentrate on high-valued crops. There should be some allowance for the element of bargaining that would be expected to drive up the price somewhat, on the assumption that the water is not to be acquired by methods involving compulsion.

SECTION 4

Note 3

This note is a direct extract from a study "Water Pricing and Allocation With Particular Reference to California Irrigation Districts", by Michael F. Brewer, Giannini Foundation Report No. 235, October,1960.

This note is an extract of Brewer's comments of the water allocation effects on district pricing behavior. Brewer discusses the costs incurred by, first single source districts and then secondly districts with ground water available.

Single-Source Districts

"In California, few irrigation districts are entirely single-source districts. Many members may not use an alternative source in a given year, but few districts are characterized by members that have not undergone the initial investment[1] required to make one available. In these few districts there has been relatively little uncertainty surrounding the expectation that the marginal cost of district-delivered water is below that of water from an alternative source over that range of output for which the marginal value product of water is greater than the marginal unit cost of district water. These conditions are met in two types of districts--those in which the marginal unit cost of district water is rendered very low by the pricing practice adopted by the district; and districts where the physical characteristics entail

[1] In the instance of the alternative being pumped ground water, the initial investment is incurred by drilling a well and acquiring pumping facilities. If the alternative source is surface water, initial outlay is involved in diversion and distribution facilities, and perhaps pumping equipment if other than gravity-flow water is involved.

a relatively high marginal unit cost of alternative water. Examples of the former are found on the east side of the San Joaquin Valley in which the revenue from the sale of electricity generated by the district is used to service and redeem bonded indebtedness as well as to pay for current operation, maintenance, and administrative expenses. Several southern California districts are situated so that the high costs of ground water pumping or acquiring nondistrict-provided surface water have rendered them single-source districts.

Members of a single-source district have, in the aggregate and individually, fewer alternative ways by which they may obtain a supply of irrigation water. However, even in a single-source district, individual members may have alternatives. Frequently, members are afforded the use of district facilities to make intermember water transfers. A district may permit the unrestricted use of its distribution facilities--that is, members make their sales and purchase arrangements individually, requesting the district to withhold and deliver the quoto involved at the time agreed upon.[1] Each member receives a district bill as though the transfer had not taken place, and the "purchase" is settled individually between the seller and buyer. More frequently, however, the individual members wishing to sell their quota are required to report this to the district engineer who also receives purchase requests. Reapportionment of deliveries is then planned by the district engineering staff in such a way that it does not interrupt the basic delivery schedule. The need for such a restricted exchange is more evident in districts with relatively limited system capacity and employing rotational systems of delivery. In at least one instance, the district also determines the price of such transfers. Annual district bills of both buyer and seller are adjusted by adding the district assessment levy of the seller to that of the buyer for the particular year in which the transfer took place.[1] If fractions of district quotas are involved, then a similar proportion of the assessment bill is transferred.

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[1] This is the case in the Turlock Irrigation District. See Article 13 of Turlock Irrigation District, Rules and Regulations of the Turlock Irrigation District (Turlock, California: Board of Directors, Turlock Irrigation Districts, 1957). Mimeographed.

For individuals within single-source irrigation districts, water use decisions are made upon the basis of the established payment complex for a given year. Although one may speculate that there is a temporal connection between the composition and magnitude of one year's payment complex and that of subsequent years, through repayment requirements or administrative commitment, no evidence was found for such an assertion. If such were indeed the case, the annually fixed cost of district assessments might become variable as disinvestment in land entered into the longer run decision context.

The Variable Cost of District Water

The average variable cost, as well as the marginal cost, of district water supply is determined by the water toll. California irrigation districts employ one of two bases on which water toll charges are calculated. These are a unit volume of water, usually an acre-foot or a rate of flow per time interval; and an area base usually specified in terms of per acre irrigated by district water. The first of these two bases is the most generally used. When it is, the average variable cost and marginal cost functions are identical, comprising a horizontal components, up to the limit that water from this source is available. This function often is discontinuous as, for example, in the Turlock Irrigation District. Deliveries to members up to 4 acre-feet per acre bear no variable cost, but water in excess of 4 feet per acre bears a total of $1 per acre-foot.[1]

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[1] In the Fresno Irrigation District, transfer between individual district members is handled by the district office. These arrangements are made annually to protect against possible development of prescriptive rights among district members. (Interview.)

When the area base is used for water tolls, the average variable cost for district water is a decreasing function. If only one unit of district water is used, this unit must bear the entire cost of the toll, whereas additional volumes are consumed per acre of irrigated land, the cost per water unit decreases. This type of charge establishes a per-acre average cost function of a hyperbolic form. The marginal unit cost associated with these circumstances is zero.

When an area toll base is used, an individual irrigator will tend to use district supplied water to the maximum possible quantity or at the quantity that represents an optimum[2] irrigation for the crops

[1] Turlock Irrigation District, _op_. _cit_., Article 1F.

[2] The choice criterion is the maximum net returns per acre. Under this type of toll, there is no marginal cost of acquiring water once a decision to use is made. The optimum will thus approximate the maximum physical yield. As a positive marginal cost of application (labor) may be assumed, the economic optimum will be somewhat less than the physical optimum.

being cultivated, whichever is smaller, on each acre irrigated by district water. The basic decision alternative will be to use district water at that quantity on a particular acre of land or to use no district water. The irrigator may decide to use water from a combination of sources on a given acre; but so long as any district water is used, he will tend to use it to the maximum with water from other sources being supplementary to the district supply.

One common form of area based water toll used by California irrigation districts entails a different charge, depending on the crops being grown.[1] This type of practice may produce an average variable cost function for water that is equivalent to a volume unit toll or it may discriminate between the production of different crops. If the ration of such crop differentiated toll is proportional to the quantities of irrigation water applied on specific crops, and the full quantity applied is obtained from the irrigation district, this type of toll will result in similar charges for a given volume unit to all irrigators using district supply regardless of the crop grown.[2] However, if a set of charges on a crop acre base are not proportional to the applied

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[1] This practice is followed by the Woodbridge, Glenn, Colusa, and Nevada irrigation districts.

[2] This, for example, is approximated by pricing practices of the James Irrigation District, which has a per-acre per irrigation charge for cotton and irrigated pasture and employs a per-acre water toll for rice. The rates used for the 1958 growing season are as follows:

Cotton	$2.00 per irrigation per acre
Irrigated pasture	$1.50 per irrigation per acre
Rice	$26.00 per acre per season

In the district, cotton is usually irrigated six times a season, with an average of 5 inches applied in each irrigation; irrigated pasture is customarily irrigated applied water; and rice averages 6 feet of water per season. On the basis of the water tolls in current use, the comparable acre-foot water toll amounts to the following:

water, the price of a water unit will differ between use for different crops in the irrigation district--a form of discriminatory pricing by the district as among crop types.

Mutiple-Source Districts

The multiple-source irrigation district is characterized by members who have available sources of irrigation water other than that provided them by their district and to which the payment complex applies. A district may operate wells, divert surface water from an appropriative filling, and import Central Valley Project water. In spite of these physically distinct sources, the payment complex obtains to all deliveries to members and hence this would be considered a single-source district if no additional supply is available to members. It is to be noted that the several potential sources of irrigation water must be sufficiently comparable in terms of quality and timing to be substitutes in irrigation agriculture.

A problem arises in the designation of multiple-source districts. If a single member of a district has a ground water pumping facility and thereby several sources for irrigation water, is the district a multiple-source district? The issue is one of degree. It is not unimportant, however, as a multiple-source district may adopt particular pricing policies specifically designed to influence the use of nondistrict as well as district sources. An example of such a district is discussed below.

2. (Continued from previous page).

Cotton	$4.80
Irrigated pasture	$4.00-$4.66
Rice	$4.33

Information from district files and interview with Mr. Kerr, Manager, James Irrigation District, June 20, 1958.

Decisions by district members as to which of several possible sources is preferred and whether that source is used in conjunction with or exclusion of other alternatives depends upon their relative costs and quantity limitations.[1] The relevancy of particular cost items depends on the time dimension of the decision being faced.

The payment complex establishes the cost structure for district water and is fixed annually. Ground water is the most common alternative source of irrigation water available to members. The costs of this water include initial capital costs of a well, equipment, and installation as well as current operating and maintenance costs. The capital outlay for well and equipment is customarily amortized over its lifetime. The length of life of a well and pump may be related to use, although this is not common. Usually the depth texture of the material in which the well is drilled, and the type of pump will determine the lifetime of such capital equipment. Under these circumstances, annual amortization becomes a variable cost only if the decision entails a time horizon that is longer than the lifetime[2] of such equipment.

The Variable Cost of Ground Water

For an irrigation farm with a well, pump and motor, the principal components of the total variable cost of water--or those costs that vary with water use--are the power cost, lubrication, and repairs on the

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1. A quantity limitation may be implicit in fixed delivery quotas used in a rotation delivery system.

2. The life of well, casing, pump, and motor varies, greatly. Differences in expected lifetime of pumping equipment installed in Kern County in 1957-1959 varied from 3 to in excess of 20 years. (Interview, Jacuzzi Bros., Inc., Richmond, California, November, 1958)

pumping plant. Capital depreciation costs and insurance costs recur annually and are unrelated to pump delivery. Of these three components of variable cost, power is the largest.

The ground-surface water-use results of district pricing practices are illustrated on the east side of the San Joaquin Valley. Many districts situated in this area obtain water from both surface streams and pumping. Irrigated agriculture within these districts almost universally employ individually owned pumping plants to supplement district water deliveries. The heavy draft upon the ground water reservoirs of the area has been reflected by increasing depths to water in most of these districts,[1] many of which now are receiving additional water from the Frinat-Kern Canal of the Central Valley Project.

Most of the districts receiving water from this canal have attempted to induce the substitution of district-delivered surface water for pumped ground water. To implement this substitution, the variable unit cost component of the payment complex--the water toll--has been established lower than that for pumped ground water."

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[1] G.H. Davis, J.H. Green, F.H. Olmstead, and D.W. Brown, Ground Water Conditions and Storage Capacity in the San Joaquin Valley, California (Sacramento: State Printing Office, 1957), pp. 167-168. (U.S. Geological Survey Open File Report.) Mimeographed.

SECTION 4: Note 4: Water Pricing

The results of some recent general studies on water value in use and marginal pricing elasticity of demand for domestic and industrial uses, and the relations of water transfers.

This note is made up of extracts from a recent P. L. D. dissertation at Stanford University in Engineering Economic Planning by John Flack, entitled "Water Transfer--An Engineering Approach".

Although Flack's study is primarily concerned with water rights, he discusses some interesting aspects of water pricing practice, relevant to California. Hence, the following extracts have been added to this current section.

Flack begins by discussing the water problem in the West and mentions demand for water and projection.

Flack continues by looking at the use of water by industry and then begins his discussion on the marginal cost of water and its relation to flexibility in meeting future water requirements compared with development of new storage.

Flack then begins an analysis of marginal cost and incremental storage provision in seven Western Regions.

For the Central Pacific Region, Flack notes the annual cost of storage for marginal yield to be lowest for all regions, namely $2.50 per acre foot. Flack finds that "except for the Central Pacific region, the marginal costs of yield from storage exceed the current prices for irrigation water.

It would be of interest to compare the costs for additional increments of sustained flow from storage, with the value-in-use of the increased yield. However, information on value-in-use of sustained yields for various purposes is not available. The value of temporal shifts in water supply to meet uneven demand schedules for irrigation has been investigated to a limited extent.

A discussion with examples and figures for Western Regions of cost of storage for marginal yield is included in Flack's report and will not be included here.

Flack continues his discussion of the marginal cost of storage by noting that the above mentioned "uneven demand schedule is" probably more realistic than a constant sustained flow because few, if any, water demands remain constant over time. It is thus likely that the incremental costs of additional yield from storage to meet an uneven demand schedule would be higher than those for a constant demand because peak demands in the West usually coincide with the low-run-off period."

The value of irrigation storage on the Kaweah River in California as reported by Moore,[21] is then discussed by Flack. "Moore found that stoarge sufficient to delay delivery of surface water by 60 days was worth $5.63 per acre per year. If it is assumed that the 1951-58 average delivery of surface water from the Kaweah River to the Tulare Irrigation District of 1.71 acre-feet per year is representative of the area, then the equivalent value would be about $3.30 per acre-foot per year.

Current charges are next discussed by Flack who states that "while the costs of storage may be substantially less than the marginal value-in-use, even in irrigation, the storage costs as computed in Table 12 are higher than prices paid for irrigation water in most of the West. Renshaw[23] has reported a mean cost of irrigation water of $1.67 per acre-foot based on actual charges as reported by the Census Bureau for 243 counties in 21 states."

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[21] Moore, C.V., "Economics of Demand in Commercialized Agriculture," Journal of the Amercian Water Works Association, Vol. 54, No. 8, August 1962, p. 913.

[23] Renshaw, E.F., "Value of an Acre-foot of Water," Journal of the American Water Works Association, Vol. 50, No. 3, March 1958, p. 303.

For a somewhat more detailed comparison, Moore and Hedges,[24] in a sample of 21 irrigation districts in the San Joaquin Valley, found that the mean cost of water per acre-foot delivered was $1.81. Irrigation districts and other organizations obtaining water from the U. S. Bureau of Reclamation pay $3.50 per acre-foot for Class I firm water and $1.50 per acre-foot for Class II water from the Friant-Kern and Madera canals, and $3.50 canalside for water from the Delta-Mendota canal. This author, in discussing this matter with local irrigation officials, learned that terminal storage of all Class II and some of the Class I water is desirable in order to adjust the delivery of water to crop requirements. At marginal costs of storage of $2.50 per acre-foot, as given for the Central Pacific region in Table 12, the firm Class I water must have a marginal value-in-use of $6.00 per acre=foot and the Class II water must be worth at least $4.00 per zcre-foot to permit construction of the terminal storage. Alternatively, transfers from low value-in-use farms to high value-in=use farms might be more economical."

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[24] Moore, C.V., and Hedges, T.R., "Some Characteristics of Farm Irrigation Water Supplies in the San Joaquin Valley," Giannini Foundation *Research Report No. 258,* University of California, September 1962, pp. 36,37.

Flack's conclusions regarding storage were that "at current or projected costs of water, irrigation will be the first economic sector to feel the competitive demand for water. Re-allocation of presently used water supplies could compete with additional storage in meeting requirements of the Western regions. Storage costs must be corrected for delivery costs which may increase significantly the difference between current charges and the marginal cost of water from storage. Inter-farm transfers could occur whenever the marginal value-in-use for any farm is greater than the current charge but less than the total marginal costs of water delivered from storage to the farm."

Flack also studied the value of water in alternative uses. Flack found that the value of water in various uses had been studies only in the last few years, although it had been long recognized that municipal and industrial uses of water could easily bid away water from irrigation. New uses such as recreation and pollution dilution may now also enter the competition for re-allocation of present water supplies, Flack mentioned.

Value according to charge (Note that charge, in practice, is not necessarily equal to value-in-use) Renshaw[25] has presented data on the value and cost of an acre-foot of water based on actual charges, alternative costs, or savings. Mean and maximum values for various uses are given in the Table below.

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[25] Renshaw, "Value of an Acre-foot of Water," JAWWA, Vol. 50, No. 3, p. 303.

TABLE 13

USE VALUE OF ACRE-FOOT OF WATER
(21 states)

Use	Mean Value $/ac. ft.	Maximum Value $/ac. ft.
Domestic	100.19	235.66
Industrial	40.73	163.35
Irrigation	1.67	27.04
Hydro-electric	0.71	5.90
Waste Disposal	1.63	2.56
Navigation	0.05	1.17
Commercial Fisheries	0.025	1.06

Irrigation values were based on Census Bureau statistics of charges for irrigation water for 234 counties in 21 states. The Maximum charge for irrigation water reported was in the San Diego area.

Flack describes how:

"So called 'values' of water determined by user charges are not likely to be very accurate because many agencies price water at average cost or less. Water costs may be subsidized through taxation or from power revenue.

It is the marginal cost of water which is important. In terms of economic efficiency the marginal costs of water should just equal the marginal productivity-in-use, otherwise, those users with higher productivity could bid away the water from the lower-valued users."

Results such as these should not lead to the conclusion that all irrigation water should be shifted to recreation or industry. Rather, sufficient flexibility should exist in water rights so that the demands of higher-valued uses can be met by obtaining water from transfers as well as from additional storage or imports.

Patterns of consumption must be adopted that make full use of other scarce resources of an area: its labor, land and capital. Limitations on these other resources, especially capital and labor, will limit the demand for water for municipal and industrial use. In all but localized areas of the West the largest portion of the water resources would remain in irrigation.

The change in dollar product per acre-foot of water for different intensities of industrialization shows that increased industrialization tends to increase the value added by industry even further compared with agriculture.

The ratios of value-added by various industrial sectors compared with agriculture were reported[28] subsequent to the New Mexico study. Designating the value-added per unit of water for agriculture as one, the other sectors ranked as follows: chemical, 179;

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[28] Wollman and Garnsey, Aridity and Man, p. 372.

petroleum refining, 47; manufacturing of food, 12; and pulp and paper industry, 10. For further explanation of this ratio, refer to Flack's study.

In discussing marginal value added in different uses in California, Flack mentions the results obtained in the New Mexico study by Lofting and McGauhey as a result of the input-output studies of the California water industry. They found, as Flack states, "the value-added per acre-foot of fresh water withdrawal for 31 economic sectors, including agriculture. The median value for all sectors, excluding agriculture, was $3646 per acre-foot withdrawn compared with $118 per acre-foot in agriculture. The various industrial values ranged from a low of $139 per acre-foot to a high of $19,515. Only withdrawal uses were included in the Lofting-McGauhey study, consequently, values-added for recreation, navigation, and hydroelectric power were not obtained."

Stream depletion and return flow were not included, however, in California Flack notes "much of the industrial use of water is discharged into the sea or so far downstream that reuse is largely precluded. In any event, it is the magnitude of the value-added in industry compared with agriculture which is of interest here."

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[30] Lofting, E.m., and McGauhey, P.H., "Economic Evaluation of Water," Part II, An Interindustry Analysis of the California Water Economy, Contribution No. 67, Water Resources Center, University of California, Berkeley, January, 1963.

Flack concludes that"in much of the West projected depletions will require large amounts of regulation of the flow. The provision of additional yields from storage and imports will involve sharply rising costs. Substantial areas of the West thus face a situation of keen competition for water.

Current charges for water indicate that transfers from low-valued uses to higher-valued uses can compete with storage in meeting future water requirements."

Flack further concludes that "while it is common knowledge that industry and municipal water users can pay substantially higher prices for water than irrigation the demand-price relationship for domestic water indicates that some reduction in use can be expected with increasing prices. Projections of water use over-estimate the demand if the elasticity of demand is ignored."

Flack mentions that "the demand function for domestic water was explored to the extent that limited available data would permit." He concluded from his study "that the elasticity of demand for domestic water is small.

Substantial price increases for domestic water will probably be followed by reduction in water use but incremental increases in prices will probably affect the use of water to a minor extent. Reductions in water use which have followed meter installation and price increases may be primarily due to the psychological effect of the meter installation and much less due to the price increases.

Long-distance importation of water and the development of huge storage projects to bring water to the arid portions of the West have been advocated by many people including prominent engineers. These schemes, if they do not recognize the price-demand relationship for water and the role of transfers, can only lead to uneconomic and subsidized water supplies. The importation of water from the Pacific Northwest or even Alaska to supply municipal and industrial users in the Pacific Southwest seems unnecessary because these users can obtain their needs by transferring water from irrigation. Irrigation, on the other hand, because of its low value-in-use, cannot pay the high costs of importation. Subsidization of irrigation water costs by power sales to municipalities and industry can only be justified if this will promote the desirable economy growth of the region, at least cost. It is contended that this justification has not been fully demonstrated."

A system of water allocation by market pricing has been proposed by Mason Gaffney and Flack describes it in his report--"this system treats water as a packageable item without regard to third party effects in its application is limited to those regions where use of return flow

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[33] Gaffney, Mason, "Comparison of Market Pricing and Other Means of Allocating Water Resources," Southeastern Water Law Conference, Water Law and Policy in the Southeast, University of Georgia, November 9, 1961.

is insignificant. Despite this limitation Gaffney's proposal has merit in the allocation of externally supplied water and it demonstrates some interesting pricing possibilities.

Briefly the proposed system would work like this. A water supply would be made available for sale at some central point. The users, assuming homogeneous uses, closest to the source would be willing to pay the highest prices because their delivery costs would be lower. Those farther from the source would be willing to pay the least. The watermaster controlling the supply would set a price to balance supply with demand and clear the market. The monies he collects would be used to finance the supply system but need not be sufficient to cover the full costs; the additional monies to be obtained by taxation as explained later. The price which would just clear the market would be the price, which when added to delivery costs, would just equal the marginal value-in-use of the water at the location farthest removed from the source. Users farther away could not afford to use the water because the total price would be too high; users closer to the source would have total water costs less than their marginal value-in-use.

The water tolls paid by the users would increase with distance from the source and away from the aqueducts leading from the source. Each users would pay the incremental use-of-facilities cost apportioned to him.

This type of marginal pricing may result in prices less than the average cost of delivering the water. It is then necessary to tap the consumers' surplus in order to pay for the system. Rather than use a complicated and discriminatory rate structure an ad valorem tax would be assessed against the entire area benefitted by the system. The assessed values would be in proportion to the benefits of the project. If water is the primary source of value to the land, it is likely that the difference between ability-to-pay and actual costs to those users nearest the source of supply would be capitalized into the value of their land. In other words, it is possible that land values would decrease with distance from the source, even though the productivity of all lands is the same, because water tolls are higher at the periphery. If this were not true a special assessment to reflect the benefits of the project would be necessary in order to establish a negative gradient for taxes with distance from the water supply source.

The high fixed charges on lands most easily served by the central source would encourage their rapid and intensive development--a desirable feature in preventing utility sprawl which greatly increases distribution costs. The centrally located landholders would pay low water tolls but high taxes, the peripheral owners would pay high water tolls but lower taxes.

Surplus water, under this system, could be sold on a short-term basis at prices estimated to clear the market. In times of shortage advance orders in the form of demand-price schedules by each user could be used to ration the water to clear the market at the best price.

Gaffney's suggestion has much to recommend it when water is distributed in a utility fashion by a municipality or irrigation district. On the other hand, unless all return flows and groundwater uses were handled in the same manner as the central water source, the method could not be used on a stream system because return-flow users would have no incentive to bid for water which they would get anyway.

"This method of optimizing allocation has practical faults. It is primarily concerned with the measurement of return flows and the capturing of unearned benefits to third parties. The permit-appropriation system in which transfers are encouraged with compensation to all parties injured as a result of the transfer would, over time, attain many of the goals attributable to these methods."

Finally, some of Flack's "ultimately reached" conclusions and recommendations are given: "Projections of water requirements when coupled with incremental price-demand analysis show clearly that transfers can compete with storage and imports in allocating water.

Municipalities and industry could readily outbid irrigation for water if permitted to do so. Yet this does not mean the end of irrigation since only small contractions in irrigated acreage or small increases in irrigation relative consumption can release sufficient quantities of water to meet the modest (compared with irrigation) demands of municipalities and industry.

Some further conclusions of Flack, which although they relate directly to water rights they indirectly influence pricing. These are listed below:--

1. If marginal transfers were permitted, that is, incremental units of water rights were bought and sold, the market for inter-farm transfers could exceed in importance transfers from irrigation to other uses. Economies of scale are prevalent in irrigated agriculture. Larger farms or those with higher productivity per unit of water can bid away water from smaller farms or those with lower productivity per unit of water.

a. "Surface and groundwater should be administered as an entity and transfers from one source to the other permitted. Groundwater mining does not have a surface counterpart and could be administered on the basis of reaping the maximum economic benefit over time considering the water as an exhaustible resource.

SECTION 4: Note 5

Alternative Methods of Financing the Proposed San Antonio Dam Project

A recent report (1963) "Alternative Methods of Fianncing the Proposed San Antonio Project" by John W. Mamer, discusses the question of water pricing, illustrates problems and approaches by reviewing the repayment plans followed by other County water agencies--mostly in the east San Joaquin Valley area. The problem of groundwater supply is also of prime concern in this report. The repayment plans followed by the California State Department of Water Resources and the U. S. Bureau of Reclamation are also reviewed. The report thus discusses in detail, many of the problems which are closely related to the problems present in Santa Clara County and is a valuable source of information. This report was made available by the Monterey Flood Control and Water District and by their kind permission, it has been attached to this report as Appendix B.

SECTION 5: Summary and Conclusions

The efficient allocation of water is theoretically achieved only when the principle marginal cost pricing is applied. Here optimal pricing consists of a rate schedule under which each class of customers (where the classes are so grouped that all customers within any single class can be served under identical cost conditions) the prices should be the same and equal to marginal costs of providing service.

Between classes, however, prices should differ, and the difference should be precisely the difference in marginal costs involved in serving the two. (e.g. extra pumping costs or longer distribution systems).

The various alternatives in water pricing have been given (PART B-Section 2). The adoption of a particular pricing scheme is seen to have many possible economic consequences. In particular water pricing is closely related to financing, in terms of revenue receipts and to allocation by use and geographical area.

The prevention of "unjust" enrichment in terms of surpluses private benefits over private costs can be directed by pricing policy. However, what is unjust subsidy in a local agency is a matter of viewpoint. From a local viewpoint political stability usually will result in a reflection of local objectives in terms of a discriminatory (generally, by type of use or quantity or utilization) pricing policy.

Most of the water agencies in Northern California, supplying water to final users, are public districts, either special districts or general units of local government. The behavior of these districts with regard to their water pricing practice and policy is best viewed as that of cooperative organizations serving the economic interests of their regular customers, particularly their politically influential constituents. Thus the political nature and structure of a public body may result in conflict of interest and hence disagreement on water pricing policy. Yet the final pricing policy is a major test of the stability of the organization and compromise and broad community support for an agencies operation is essential.

The operation of each public district is also dependent on a satisfactory financial position where all costs are recovered yet total net revenue is small. The decision to expand usually is based on simple tests of "adequacy" of the existing supply and financial feasibility rather than full economic analysis.

The public water agencies may be split into two broad classes--urban or combined water agencies and agriculturally dominated agencies. Agricultural districts usually charge a constant price for water containing a water toll proportional to the amount of water sold and a tax levy on property. Urban agencies usually have a declining block rate pricing schedule and also levy property taxes based on improved property valuation.

The combination of taxes and prices has complex implications on the financial position and development trends of the district and these were outlined (See Section 4-Note 1). Water Pricing may be further complicated by the existence of underlying ground water basins.

The incorporation of a ground water pump tax is most desirable for the protection of the basin and should be set at such a level that prevents injurious overdraft if it is the desire of the district constituents to maintain "for all time" the basin. However, provided the value of the basin can be determined on a exhaustive basis then that value can be used to set the ground water toll if the constituents desire to mine to exhaustion the underlying ground water. In this way, the basin is treated as other exhaustable resources; although here on a more localized scale as exhaustion may mean very expensive transportation costs when new water supply becomes necessary.

In Agricultural districts, with strong water rights, it is likely that excessive water use prevails. The practice of rationing in these districts further adds to inefficient water allocation as marginal productivity is not tested. Further, in most agricultural districts, water use is closely related to average total unit costs (taxes plus toll) rather than to average variable costs (tolls alone).

In urban agencies, on the other hand inefficiency results from the use of declining tapered rates which introduces a price discrimination between user groups which may be just as important a contribution to inefficient pricing as the differential to agricultural users and their own inefficiences of operation already mentioned.

The agencies studied form only a small sample of the hundreds of water agencies in California. However, they do exhibit the characteristic behavior of most other districts of their respective types.

The use of a differential price based on class of use (usually favoring agriculture) was common. This differential for agricultural water versus municipal and industrial was found to be based either upon the wholesale price if purchased from the M.W.D. or obtained from a federal project, or on a straightout district policy where agricultural interests hold strong political influence (e.g. Irrigation Districts).

In these districts where a differential price is used, the willingness of municipal and industrial users to pay their part of the cost of agricultural water doubtless reflects: 1) their desire to establish current use or 2) their willingness to support local agriculture, or 3) their lack of sufficient political strength in policy determination or 4) their willingness to simply accept their own rate charges without concern of the implicit subsidy to agriculture.

It was observed that none of the larger districts supplying both agricultural and domestic water applied any form of marginal costs pricing. None of the districts even imposed seasonal pricing.

In as far as rates reflected, the relative costs of providing service their absolute values were not questioned for each district studied. However, the structure of the rate schedules exhibited serious faults principally, differentials and declining block rates.

Administration charges imposed by agencies purchasing M.W.D. of S.C. water were on a per acre foot basis. This per unit basis for applying an additional district charge (if it only reflects administration costs of billing, etc., and not distribution costs) seems inequitable with even sub-optimal water pricing at local district level.

Further, the use of a declining block rate, which favors quantity users promotes inefficient use of water, however, as explained earlier, this is a result of overbuilding in many districts where stage construction should have been applied.

It is thus concluded that little attempt is being made at the local level to achieve optimal pricing. The political and legal aspects are, of course, extremely important in the water allocation process and these factors do prevent economic efficiency. However, it appears that practical improvements compatible with local district objectives and goals for development can be made by modifying existing rate structures. The desired principle of marginal cost pricing can certainly be approached in the short run where it may be applied by season, by type of use and to special cases such as new sub-divisions where the incremental cost of extending distribution (i.e. the marginal cost of service) is fairly readily and accurately calculable.

The constituents of a district rarely realize the full implications of inefficient water pricing, thus it is for the decision makers to aid their constituents by striving towards efficient policies which still reflect the true desires of the community they serve.

APPENDIX B:

"Alternative Methods of Financing the Proposed San Antonio Dam Project",

--A Report by John Mamer.